THE GEOGRAPHICAL REVIEW

CONTENTS FOR OCTOBER, 1936

PAGE

The Lakes of Potosí 529
By William E. Rudolph

Galicia: A Little-Known Corner of Spain 555
By E. H. G. Dobby

The Submerged Forest of the Columbia River Gorge . . 581
By Donald B. Lawrence

An Empirical Classification of Flood-Plain Streams . . 593
By F. A. Melton

A Southwestern Oasis: The Roswell Region, New Mexico . 610
By Ralph H. Brown

The Diversity of New York City: Comments on the Real Property Inventory of 1934 620
By John K. Wright

The Geography of North America: A History of Its Regional Exposition 640
By W. L. G. Joerg

The Geography of the Oceans: A Review of the Work of Gerhard Schott 664
By Preston E. James

Geographical Record (*listed on the next page*) 670

Geographical Reviews (*listed on the next page*) 691

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GEOGRAPHICAL RECORD

NORTH AMERICA

Migration and Economic Opportunity in the Great Plains. *By Lois Olson* 670

Ethnic-Group Colonization in Western Canada. *By Fred T. Marsh* 672

The Amana Community 674

Two Different Types of Industrial City in Pennsylvania 674

SOUTH AMERICA

The Soil Geography of South America. *By Preston E. James* 675

Natural Regions of São Paulo. *By Preston E. James* 676

Land Settlement in Brazil. *By Preston E. James* 677

EUROPE

Agriculture and Land Reclamation in Italy 678

The Geography of Sardinia 679

The Olive Industry of Spain 680

The Ebro Delta: A Pioneer Area in Catalonia. *By Alice Foster* 681

The Population of Austria 682

London as an Industrial City. *By Lois Olson* 682

AFRICA

The Evolution of the Congo Basin 683

A Description of Ifni. *By Raymond E. Crist* 684

ASIA

Quelpart and Dagelet. *By Robert Burnett Hall* 684

The Place of Hokkaido in the Japanese Population Problem. *By Darrell Haug Davis* 685

Climate and Soil Formation in South India. *By A. V. Williamson* 686

Monthly Fluctuations of Sea Level in Ceylon. *By H. A. Marmer* 687

THE OCEANS

Atmospheric Circulation over the Indian and Pacific Oceans. *By John Leighly* 687

PHYSICAL GEOGRAPHY

A Contribution to the Theory of Climatic Fluctuations. *By John Leighly* 688

HISTORICAL GEOGRAPHY

Was Bering Strait Known in the Sixteenth Century. *By Dana B. Durand* 690

GEOGRAPHICAL REVIEWS

The Western Range. *By Isaiah Bowman* .. 691

HOWARD W. ODUM. Southern Regions of the United States 692

CHARLES E. KELLOGG. Development and Significance of the Great Soil Groups of the United States. *By Arthur R. Hall* ... 693

THOMAS BARBOUR AND MARGARET DEWAR PORTER. Notes on South African Wild Life Conservation Parks and Reserves. *By Aldo Leopold* 694

E. H. CARRIER. The Pastoral Heritage of Britain 695

H. C. DARBY, edit. An Historical Geography of England before A. D. 1800 696

EDG. KANT. Bevolkerung und Lebensraum Estlands: Ein anthropoökologischer Beitrag zur Kunde Baltoskandias. *By Eugene Van Cleef* 698

GEORGES LE FÈVRE. An Eastern Odyssey: The Third Expedition of Haardt and Audouin-Dubreuil. *By E. Muriel Poggi* 699

R. C. F. SCHOMBERG. Between the Oxus and the Indus. *By E. Muriel Poggi* 699

ELLA K. MAILLART. Turkestan Solo: One Woman's Expedition from the Tien Shan to the Kizil Kum. *By Muriel Poggi* 699

EVANGELINE FRENCH, MILDRED CABLE, AND FRANCESCA FRENCH. A Desert Journal: Letters from Central Asia. *By E. Muriel Poggi* 699

P. C. VISSER AND JENNY VISSER-HOOFT, edits. Wissenschaftliche Ergebnisse der niederländischen Expeditionen in den Karakorum und die angrenzenden Gebiete in den Jahren 1922, 1925 und 1929/30. *By Hellmut de Terra* 701

P. M. VAN RIEL. The Bottom Configuration in Relation to the Flow of the Bottom Water. (The Snellius Expedition.) *By C. Iselin* 702

F. PINKE. Depth Determinations. (The Snellius Expedition.) *By H. C. Stetson* ... 702

P. H. KUENEN. Geological Interpretation of the Bathymetrical Results. (The Snellius Expedition.) *By H. C. Stetson* 702

JULIAN S. HUXLEY AND A. C. HADDON. We Europeans: A Survey of "Racial" Problems. *By H. J. Fleure* 704

THE
GEOGRAPHICAL REVIEW

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THE LAKES OF POTOSI

William E. Rudolph

THE lakes of Potosí have been rebuilt. Three and a half centuries after the beginning of work on this marvel among water-supply systems, one of the great engineering feats of its time, the lakes are to function again as in the days when they made possible the glory of the *Villa Imperial*. Construction of the system began in 1573 and was completed in 1621, with some thirty-two lakes furnishing the water to turn the wheels of the silver mills. Through the following years the fortunes of the city, one might say, rose and fell with the lakes. Does this rehabilitation of the lakes augur a new prosperity for the ancient city?

At the height of its prosperity Potosí had an accredited population of 160,000. Today the city numbers some 30,000 inhabitants. Its 200 blocks of houses stand in irregular rows of narrow, winding streets at the foot of the 15,680-foot cone of the Cerro Rico. Old churches and other old buildings in different degrees of preservation[1] link present-day Potosí with those traditional days when it sent to the Spanish crown the lion's share of the silver that played so large a part in shaping the course of the world's history. "There is no city in America that conserves its Spanishism with more love than Potosí."[2]

For a place of its size Potosí, at 13,780 feet (4200 meters), has no rival in altitude save Cerro de Pasco, at 14,200 feet, with a population of 20,000. The province of Frías, in which Potosí is situated, is well named. Recent figures[3] give the city an annual mean temperature of 7.8° C. (46° F.); the average winter temperature has a daily range from −16° C. (3° F.) to 7° C. (45° F.). The spring months,

[1] The Sociedad Geográfica de Potosí has taken a hand in the preservation of some of the old buildings, among them the Casa de Moneda, which however does not antedate the eighteenth century. A description of the Moneda, as it is today, appears in Hiram Bingham's article, "Potosí," *Bull. Amer. Geogr. Soc.*, Vol. 43, 1911, pp. 1–13.

[2] W. J. Molina: La Ciudad Unica, Buenos Aires, 1927.

[3] Luis Subieta Sagárnaga: Potosí Antigua y Moderno, Potosí, 1928, p. 2.

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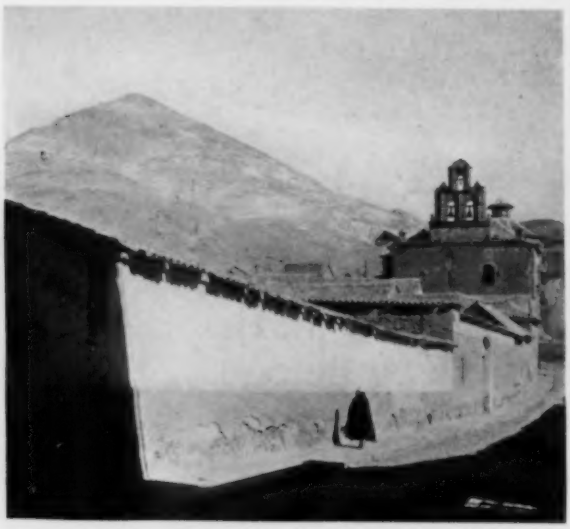

FIG. 1—The famous Cerro Rico dominates the scene in Potosí.

October to December, are usually warmer than the summer months, January to March, because of their bright sunshine, in contrast with the clouded skies of summer. After a residence of more than two years in Potosí the writer does not find the climate of the city itself any more inhospitable than that of Uyuni or Oruro or other cities of the altiplano proper, but early Spanish accounts all emphasize the rigors of the climate: "sumamente frío y seco," says an anonymous description of the city in 1603.[4] In his "Crónicas Potosinas"[5] Omiste records some disastrous storms of the early days; for instance, in August, 1557, snow fell continuously for 11 days to a depth of more than a vara (32 inches) and caused many deaths. In his "Anales de Potosí" Bartolomé Martínez y Vela[6] reports under date of 1640 that "the frightful storms, the terrible snows, and the insufferable cold" began to ameliorate.

However, the dryness of the climate is more pertinent to our present inquiry. The yearly precipitation at Potosí is about 25 inches, and most of it falls in the three summer months. From October to December there are occasional showers of hail, sleet, and snow, but it seldom rains at this season. Evaporation is great. The scarcity of water early offered an obstacle to the mining industry. "For silvers sake men desire a good yeere of raine in Potosi, as they doe in other places for bread."[7]

[4] Relaciones geográficas de Indias: Perú, Vol. 2, Madrid, 1885.

[5] Modeste Omiste: Crónicas potosinas, Vol. 2, La Paz, 1919; see also Vicente G. Quesada: Crónicas potosinas, 2 vols., Paris, 1890, Vol. 1, pp. 251–253.

[6] Published in Archivo Boliviano, Vol. 1, Paris, 1872, pp. 282–490 (Quesada drew largely on this account for his Crónicas potosinas" and both were used by Bernard Moses for his chapter on Potosí in "The Spanish Dependencies in South America," 2 vols., New York and London, 1914, Vol. 2, pp. 1–26). Bartolomé Martínez y Vela was also the author of a larger work, for information on which we are indebted to Mr. Lewis Hanke of Harvard University. It is entitled "Historia de la villa imperial de Potosí, riquesas incomparables de su famoso cerro, grandesas de su población, sus guerras civiles, y casos memorables," and it was written about 1770. The manuscript is in the Biblioteca del Palacio Nacional (formerly the Royal Library) of Madrid and has not been published save for "Volume I," by Luis Subieta Sagárnaga in Potosí in 1925.—EDIT. NOTE.

[7] Joseph de Acosta: The Natural & Moral History of the Indies, reprinted from the English translated edition of Edward Grimston, 1604, 2 vols., *Hakluyt Soc. Publs.*, Ser. 1, Nos. 60 and 61, London, 1880, Vol. 1, p. 222.

The Creation of the Lakes

Fig. 2—A street in Potosi.

To the viceroy Francisco de Toledo is given credit for the project of the lakes of Potosí. The riches of the Cerro Rico had become known to the Spaniards in 1545, when the Indian Diego Gualca shared the secret of his discovery with his master Villarroel; but during the next two decades the ores ran so high in silver that only primitive smelting furnaces were needed to refine them. By 1566 these rich ores had been exhausted, and it became evident that other means must be found for treating less valuable ores if the demands of the Spanish crown and the greed of the individual miners were to be satisfied. It was perhaps the threatened decrease of silver shipments to Spain that prompted the viceroy's visit to Potosí in 1572, when he called a convention of the miners to consider the construction of ore-grinding mills operated by hydraulic power. The suggestion was greeted with enthusiasm, but unfortunately there was no permanent stream for furnishing such power closer than 15 kilometers. The inhabitants of the town depended on springs whose total flow amounted to some twenty or thirty liters a second during the dry season. Then it was that four prominent miners, Captains Illanes and Iñigo de Mendoza, Sebastián de Arlés, and Villafranca, offered to build at their own expense a lake to impound the summer rains so that there might be water the year round. The viceroy, by way of coöperation, offered to assign 20,000 Indians for building the waterworks and a force to maintain them in perpetuity. The offer was legalized by royal cedula dispatched by Philip II in 1574. A beginning was made with the lake Tabaco Nuño, later renamed Chalviri, 7 kilometers southeast of the Cerro of Potosí.

Completion of the Chalviri lake, far from solving the miners' problems, created new ones. Hardly had the lake water begun to function at the mills erected just below the lake than the difficulties of transportation became apparent. More than 2000 llamas were needed to carry the ore from the Cerro to the water. That it would be easier to bring the water to the ores soon became clear. Other

FIG. 3—Another view of the Cerro.

miners wished to construct mills near Potosí and to use the waters of Chalviri by building an aqueduct to the city. To this the four owners of the lake agreed on condition that mills be constructed for them near the Cerro to replace those built near Chalviri. So was the first water brought to Potosí.

The inauguration of its water supply marked the beginning of the great glory of Potosí. More lakes were built—according to some historians, a total of 32, with storage capacity of perhaps 6,000,000 metric tons. A channel, Ribera de la Vera Cruz de Potosí, as it was called by Corregidor Pereyra, was built through the city for dropping this water through a vertical height of 594 meters, to operate the 132 mills, *ingenios*.

FIG. 4—One of the *pilas* where the people of Potosí go for water.

FIG. 5—Scene along the Ribera, with one of the old bridges.

The average amount of water flowing in the Ribera may be estimated at about 250 liters a second. The summer rains served not only for filling the reservoirs but also for supplying the Ribera during the three rainy months. According to the writer's calculation, after April 1, when the lakes began to be drawn down, evaporation and seepage losses would be about compensated by the flow of feeders, which continues in some *quebradas* until July or August. Despite the low efficiency of the primitive wooden water wheels used by the Spaniards, it is likely that they generated a steady 600 horsepower at the mills. Each millowner was allowed the use of the waters of the Ribera to run his plant, but he was obligated to deliver this water at the proper level to his neighbor downstream.

FIG. 6—Looking down the Ribera; masonry canal (left of center) for turning water wheel.

Construction Methods of the Spaniards

The water-supply system of Potosí has met in remarkable manner the test of time. The engineers who planned and carried out the work were highly skilled. The product of their labors would have been well worthy of engineers of today. What background in water-

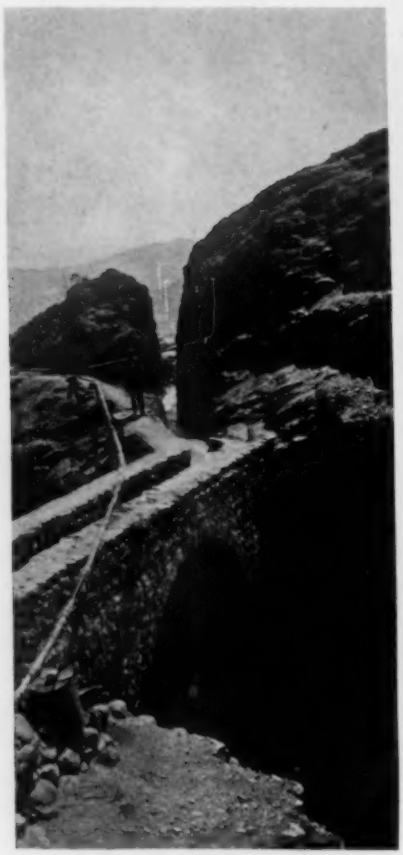

Fig. 7

Fig. 8

Fig. 7—A canal for using water of the Ribera to turn an old water wheel crosses the Ribera on an old bridge.

Fig. 8—Atop the Cerro Rico.

supply work did these colonial people have, to produce so remarkable a feat of engineering? Was it the Roman or Moorish heritage of arid Iberia? In any case they were called on to solve many new problems when they transferred their activities to the mountain region of South America.[8]

[8] Mr. Hanke remarks that the Spanish hydraulic engineers also encountered formidable problems in Mexico, for instance in the construction of the drainage system to protect Mexico City from floods.

The dams were built of earth and masonry. A transverse section of the higher dams—as at Chalviri, where the original height was 8 meters—shows five different layers, forming a total thickness of 10 to 12 meters. First, on the upstream face, to withstand wave action, is a dry wall of rock about 75 centimeters thick; next is a fill of clay; next a wall of stone in lime mortar, as thick as 2 meters at the greater depths; then another fill, of clay and sand; and a downstream wall of stone in lime mortar. The last two are not brought up to the full height of the dam. At less important dams, where the pressure of only 3 meters of water was to be resisted, there were upstream and downstream walls of masonry, some with mortar and many without, and a clay with earth filling between. It is not easy to distinguish between the original structures of the Spaniards and the repairs and embellishments of those who followed. The older historians give little information on this subject, treating the history of the lakes in too general a way to record details.

FIG. 9—A street in Potosí, showing the tower of San Francisco church.

An intricate system of aqueducts was built to convey waters from one lake group to another and, eventually, to the Ribera, which feeds the mills. The waters of all but the two northern groups flow by canals and cascades to Lake San Sebastian and from this lake enter the Ribera (Fig. 14). Yet there are indications that this was not the original idea. For instance, there are the remains of an old canal on the north slopes of the *quebrada* of Lobato, which drained Lake Ulistía at a much higher level than the Chalviri canal, into which these waters later flowed. Similar canals are found near Lake Muñiza and the defunct Lake San Lázaro.

The canals were built with walls of stone in lime mortar. They averaged about a meter in width and about 80 centimeters in depth; the main canals are inclined about 7 meters a kilometer, the subsidiary aqueducts 5 meters or less a kilometer. The canals wind along the slopes of the Karikari range; in places they are cut into the pre-

cipitous rock cliffs. Twice the canal from Chalviri passes through tunnels, once in rock, once in moraine 320 meters long. At one point the canal from San José is built upon a masonry wall 20 meters high. There are some six scenic cascades where the canals drop their water from a watershed divide to a lake or valley below.

The Ribera was also a work of magnitude. Five kilometers in

FIG. 10—Many old buildings in Potosí link the city with the days of its greatness.

length and eight meters in width, it was constructed with walls of rock in lime mortar, which time has destroyed. Over it 22 bridges furnished street crossings in the city.

VILLA IMPERIAL

With the waters of the Ribera flowing constantly, Potosí flourished. Well deserved were the words that Charles V had placed upon its first coat of arms, "Soy el rico Potosí, del mundo soy el tesero, soy el rey de los montes y envidia soy de los reyes,"[9] and the more modest legend on the shield sent by Philip II, which is used to the present day, "Pro Cesaris potentia, pro regis prudentia iste excelsus mons et argenteus orbem debellare valet universum."[10] The fame of the *Villa Imperial* spread to all parts of the world. Martínez y Vela thus enumerates the products brought back by its exports of silver:

> . . . silks of all sorts and knitted goods from Granada; stockings and swords from Toledo; clothes from other parts of Spain; iron from Viscaya; rich linen and knitted goods from Portugal; textiles, embroideries of silk, gold, and silver, and felt hats from France; tapestries, mirrors, elaborate desks, embroideries, and laces from

[9] "I am the rich Potosí, the treasure of the world, the king of mountains and the envy of kings."

[10] Several different versions of the legend exist showing a text altered or corrupted in a number of places. The above text is supplied by Professor Frank G. Moore, of Columbia University, and Mr. Lewis Hanke. Professor Moore translates it thus: "For the powerful Emperor, for the wise King this lofty mountain of silver could conquer the whole world."

Flanders; cloth from Holland; swords and steel implements from Germany; paper from Genoa; silks from Calabria; stockings and textiles from Naples; satins from Florence; cloths, fine embroideries, and textiles of excellent quality from Tuscany; gold and silver braid and rich cloth from Milan; sacred paintings from Rome; hats and woolen textiles from England; crystal glass from Venice; white wax from Cyprus, Crete, and the African coast of the Mediterranean; grain, crystals, ivory, and precious stones from India; diamonds from Ceylon; perfume from Arabia; rugs from Persia,

FIG. 11—Ruins of old mills as the flood left them after the collapse of the San Ildefonso dam in 1626.

Cairo, and Turkey; all kinds of spices from the Malay Peninsula and Goa; white porcelain and silk cloths from China; negro slaves from the Cape Verde Islands and Angola; cochineal, dyes, vanilla, cocoa, and precious woods from Spanish America and the West Indies; pearls from Panama; rich cloths from Quito, Riobamba, Cuzco, and other provinces of the Indians; and various raw materials from Tucumán, Cochabamba, and Santa Cruz.[11]

Even in its earliest days the great fair of Potosí was famous. "I believe that no other fair in the world can be compared with it," said Cieza de Leon.[12] The proud inhabitants of the *Villa Imperial*, during those halcyon years of the first quarter of the seventeenth century, can have little dreamed that the same waters that brought fame to their city were also to take it away. On the fifteenth of March, 1626, the San Ildefonso dam broke, and in less than two hours' time its waters had destroyed the prosperity of 50 years' building. The tragic story of that terrible Sunday afternoon is still recounted in Potosí: how 126 of the city's 132 mills were destroyed (79 of them irreparably), along with 46 blocks of Spanish quarters, 370 houses of Spaniards, and 800 ranchos of Indians. The dead have been placed by some historians at more than 4000 (a census made by the Jesuits gives 3800), the loss of property at 12,000,000 *pesos fuertes*.

[11] Martínez y Vela, Anales de Potosí, pp. 411–413.

[12] Pedro de Cieza de Leon: The Second Part of the Chronicle of Peru, *Hakluyt Soc. Publs.*, Ser. 1, No. 68, London, 1883.

Potosí never completely recovered from the San Ildefonso disaster. The dam was quickly repaired, the lake was put back in service, and the more important of the *ingenios* were rebuilt. Other adventurers came from Spain to take the places of those who had drowned. As to the Indians, *qué importa?* Was there not an endless supply? But a certain morale had been lost. Miners are notoriously superstitious,

FIG. 12—The city of Potosí seen from the top of Cerro Rico.

and the catastrophe furnished ample cause for superstition in a city notorious for wealth and wickedness. The survivors saw in the event the visitation of divine retribution, and they were confirmed in this belief by the miracle of the San Francisco church, saved by the division of the waters, which left it unharmed, an island in the flood. Martínez y Vela records that at each gathering of clouds the townsfolk forsook their houses, to pray in the streets and plazas, thus publicly repenting their sins and pleading divine mercy.[13] When the ill-fated day had been forgotten, it was too late to restore the former level of prosperity.[14] The bulk of the silver was gone, and a long decline set in. Although from time to time hopes have been roused—by the discovery of a new vein or an improved process of recovering metal from the ore—silver has not been able to restore the former glory of the *Villa Imperial*. If the fortunes of Potosí are to be

[13] Omiste, *op. cit.*, Vol. 1, p. 190. Also Alberto de Villegas: La Campana de Plata. La Paz, 1925, p. 152.

[14] It is not implied that the water-supply system was of exclusive importance in the fortunes of Potosí. The introduction of the quicksilver amalgamation process (c. 1573) and the discovery of new veins, for instance, had an important relation to the amount of silver produced. Moreover, as Mr. Hanke points out, the fortunes of Potosí may not have fallen quite so suddenly as some of the chroniclers suggest; and he cites Humboldt's figures of silver production in the seventeenth century (Alexandre de Humboldt: Essai politique sur le royaume de la Nouvelle-Espagne, 2nd edit., Paris, 1827, Vol. 3, pp. 363–364). Complete statistics of the silver output of Potosí would be invaluable were they available.

rebuilt—and at last they have taken a definite upward trend—they will rest not on silver but on a baser metal, tin.

New Resources in Tin

Tin had been known about in the Cerro of Potosí almost back to the days of the discovery. One of the four rich silver veins dis-

Fig. 13—Looking at the backbone of the Karikari Range from the Cerro Rico. Lakes San Sebastian and Planilla are seen in the left center, with Lake San Ildefonso directly above.

covered about the middle of the sixteenth century was named Estaño. However, until the last decade of the nineteenth century the hill had been worked almost exclusively for silver, inasmuch as the tin commanded an extremely low value, 8 bolivianos per quintal smelted. However, in 1891 the United States government demonetized silver and adopted the gold standard. Immediately the Bolivian exchange dropped from 44 pence to 23 pence, at which exchange the silver mines could not continue operations. With the price of tin £52 sterling a ton (which represented nearly twice as many bolivianos as before the break in silver), the exploitation of tin was begun.[15]

Tin production increased rapidly. The product was smelted and shipped as bars until 1912, when, with the opening of the Potosí to Río Mulato railroad, it was possible to ship concentrates that weighed 40 per cent more. Despite severe fluctuation in the price of tin, its production at Potosí has increased steadily, and this trend of increase has been greatest during the past four or five years. Not only are veins being exploited for tin in the upper part of the hill, where the Spaniards found their wealth of silver, but mine development is being carried on at great depths, where there are no silver ores at

[15] The writer is here indebted to the unpublished notes of Luis Soux, a pioneer in the exploitation of tin minerals of Potosí.

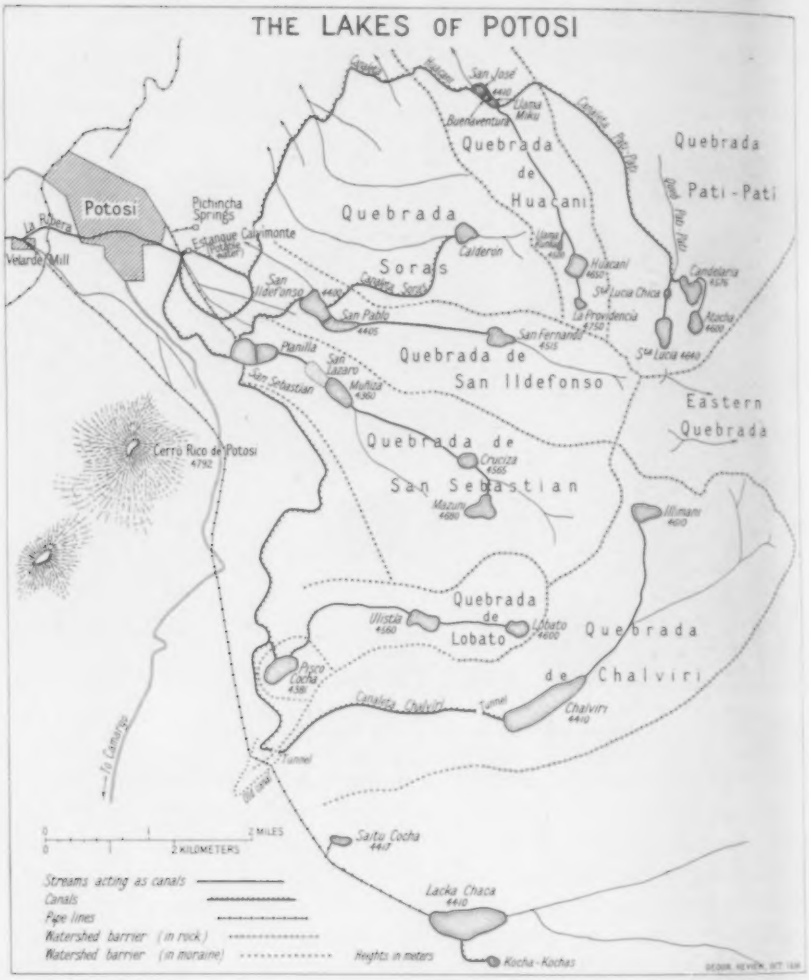

FIG. 14—Sketch map of the lake system of Potosí; scale approximately 1 : 115,000. The city is situated in 19° 34′ 18″ S. and 65° 34′ 25″ W.

all. The old discarded dumps of the Spaniards and the fills that they made in some of their tunnels are also being milled for tin.

NATURAL FOUNDATION OF THE LAKES

The lakes of Potosí had their beginning many thousands of years before the arrival of the Spanish engineers. The Karikari range, which runs in a north-south direction east of Potosí, was formed as a huge batholith beneath a surface perhaps two kilometers higher than at present.[16] The mountain mass was eroded in the late Tertiary

[16] The quartz-porphyry plug at the center of Potosí hill, forming a volcanic neck within the older shales surrounding it, has been considered by some geologists to be a lateral valve of the formation of the Karikari batholith. As fossils of flora of the late Tertiary have been found among the volcanic tuffs in the upper part of the hill, the age of the mineralization of the hill has been established.

TABLE I—CAPACITIES AND OTHER DATA REGARDING THE LAKES

Name	*Metric Tons*	*Remarks*
Illimani	120,000	Narrow, low dam where trench was dug by Spaniards to drain original lake.
Chalviri	2,900,000	Dam 8½ m. high by 226 m. long, rebuilt in 1935 to 9.88 m. by 274 m.; lake perimeter when full 5½ km.
Lobato	200,000	Narrow, low dam where canal some 300 m. long was dug by Spaniards to drain original glacial lake.
Ulistía	360,000	Original name Patos ("ducks") well deserved judging from number of old stone arrowheads found about its shores. Main dam at west 5 m. by 188 m., small supplementary dam at southeast corner; lake perimeter 1800 m.
Pisco-Cocha	340,000	Tunnel 220 m. long cut by Spaniards through moraine to drain original lake.
Mazuni	55,000	Narrow, low dam where nearly one-half km. of trench in rock cut to drain original glacial lake.
Cruciza	47,000	Dam 6½ m. high originally, now less than 5 m.; 64 m. long; lake perimeter 2380 m.
Muñiza	175,000	Dam 5½ m. high, but 1½ m. of sediment has filled lake; dam 214 m. long; lake perimeter 1600 m.
Planilla	90,000	Originally named San Pedro. Dam 5½ m. by 105 m.; lake perimeter 1390 m.; depth of sediments about 1 m.
San Sebastian	300,000	Also known as San Salvador in early days. Dam 7 m. by 200 m.; lake perimeter 1750 m.
San Fernando	230,000	Low, narrow dam.
San Pablo	275,000	Originally named De la Reina. Dam 5½ m. by 235 m.; lake perimeter 1870 m.
San Ildefonso	430,000	Originally named Del Rey, also Karikari. Dam 8 m. by 500 m.; lake perimeter 2800 m.
Calderón	100,000	Original name unknown. Lake rediscovered in 1935 and rebuilt.
Providencia	85,000	Low, narrow dam. Tunnel in rock 40 m. long drains original glacial lake.
Huacani	315,000	Also known as Huancaní in colonial days. Dam 6½ m. by 100 m.; lake perimeter 1420 m.
Llama-kunka	11,000	Unimportant lake, perhaps work of Indians in recent years.
Llama-miku	40,000	Old dam found buried to top in mud, about 5 m. below surface; new dam 3 m. higher.
Buenaventura	12,000	Mere settling basin.
San José	12,000	Mere settling basin.
Atocha	180,000	Dam 3 m. by 90 m.; lake perimeter 1720 m.
Candelaria	45,000	Two low dams; unimportant lake.
Santa Lucia	130,000	Dam 3½ m. by 100 m.
Santa Lucia Chica	4,000	Unimportant settling basin.

Total capacity of present system 6,456,000 metric tons.

and Pleistocene. Glaciation played a prominent part. Its activity centered about a point eight kilometers due east of the Cerro Rico. In the part of the Karikari nearest to Potosí are eight glacial troughs, all of which except the easternmost lent themselves to development of the water-supply system. Beginning clockwise from the south, these

FIG. 15—An eighteenth-century drawing of a part of the lake system of Potosí. Lakes San Ildefonso and San Pablo are seen and the chapel of San Ildefonso, just west of which occurred the disastrous break in the dam in 1626. Reproduction on a reduced scale from the manuscript "Historia de la villa imperial de Potosí" by Bartolomé Martínez y Vela (see footnote 6). The opportunity of making this reproduction and that of Figure 16 is due to the kindness of Mr. Hanke.

quebradas with their present lakes are: (1) Quebrada de Chalviri or Tabaco-Ñuño (2 lakes), (2) Quebrada de Lobato (3 lakes), (3) Quebrada de San Sebastian (5 lakes), (4) Quebrada de San Ildefonso (3 lakes), (5) Soras Quebrada (1 lake), (6) Quebrada de Huacani (6 lakes), (7) Quebrada de Pati-Pati (4 lakes). The eighth quebrada, draining eastward, also contains lakes, but of these only the lakes Samasa and Talacocha are in condition. Yet there are remains of old dams in this quebrada, of construction similar to the early work of the Spaniards. They may have been built for irrigating land near Chaqui and Puna to grow foodstuffs for the vast number of workers engaged in the mines of Potosí.

In the cirques excavated in the hard crystalline rock at the head of the quebradas the Spaniards found lakes without outlets when they began their building program: Illimani, Chalviri, Lobato, Mazuni, Providencia, and Huacani are good examples. Use of this type of lake involved the building of a dam and the excavation of a ditch or tunnel to provide an exit for the waters. These lakes usually contain "dead water" below the level of the outlets. Farther down

the quebradas the glacial debris was deposited as lateral and frontal moraines. The principal lateral moraines are shown upon the map; they evidently function as watershed barriers between quebradas where the solid-rock ridges cease to outcrop. Here the Spaniards found no natural lakes except Pisco-Cocha, which is entirely surrounded by moraines.

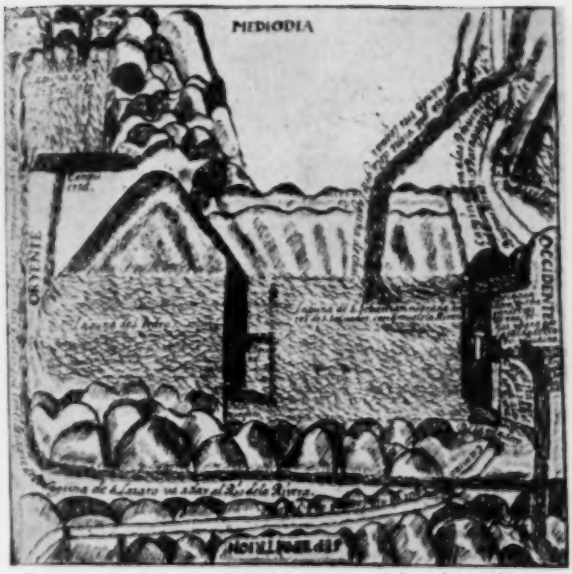

FIG. 16—Another part of the lake system of Potosí (see Fig. 15). This shows Lakes San Sebastian and San Pedro (Planilla).

The natural barriers of loose materials that the frontal moraines formed after the ice had melted were able to hold back water for only a relatively short time before erosion cut through and it drained off. But the Spaniards had only to rebuild the natural dams to reëstablish the lakes. San Ildefonso and Muñiza are lakes formed in this way, but the best example is Lacka Chaka, a new lake created during 1934 in one of the quebradas south of the Spanish system.

When the two types are compared, the first, or rock-bound, lakes offer most advantages. Filtration losses are small in rock formations, whereas the porosity of the moraines permits heavy seepage through the bottoms and sides of the lakes of the second type. Moreover, most of the actual seepage from the rock-bound lakes probably finds its way to other lakes and the canals; whereas seepage from the moraine-bound lakes sinks to deep levels, and even though it may appear at the surface elsewhere as springs, their level is too low to be used at Potosí. Evaporation losses are also much smaller in the rock-bound lakes; for, although the air is more rarefied at these higher altitudes, the lakes are sheltered from sun and wind, and temperatures are lower. Furthermore, the water entering the rock-bound lakes has flowed mainly over rock surfaces and carries only a small amount of sediment, whereas the streams traversing the loose moraines farther down the valleys carry a large amount of sediment and are gradually filling up their basins. Lake San Lázaro, for instance, is now completely filled with sediments and is permanently out of use; and Lake San Sebastian contains an average depth of

FIG. 17—Looking downstream toward old Chalviri dam, lake being half full. The canal is tunneled through the dark hill in rear of dam.

95 centimeters of soft sediments on its floor and has lost 85,000 metric tons of its capacity.

Why, then, did not the Spaniards build all their lakes within the rock formation? It is significant that they began with Chalviri, the best lake of all. Unfortunately other appropriate sites like Chalviri and Huacani for impounding large lakes within the rock formation were not to be found; all the other lakes of this type are small. On the other hand, there were numerous *vegas* of fair dimensions that could be utilized for lakes of the second type, and, although large dams were usually required at these locations, clay and sand were close at hand for building needs.

FIG. 18—Looking upstream toward Chalviri dam and outlet canal.

FIG. 20—Remains of dam of "lost" lake found by the writer in the Soras quebrada in 1935, and now put into service.

CHANGES IN THE LAKES

Many changes have occurred in the lake system since it was built. Some lakes have disappeared. The historians mention names for which we have no lakes today: San Lorenzo, San Joaquin, Estaño, Redondilla, Santa Barbara, Estanquilla, Cajoncilla. The original decree of the viceroy Francisco de Toledo called for the building of 18 lakes, but historians have recorded that there were as many as 32. There are now 24 in service; one other, San Lázaro, has become filled with sediments to the full height of its dam and is no longer utilizable.

Undoubtedly one of the lost lakes was in the San Sebastian quebrada at a narrow gorge a short distance above Lake Muñiza, where

FIG. 19—The Chalviri aqueduct.

there is an excellent lake site, which the efficient Spanish engineers are not likely to have overlooked. There are two other sites in this quebrada and one in the San Ildefonso quebrada, which were probably used by the Spaniards. These lakes may have been destroyed by floods, though no remnants are left to tell the story. At San José there was probably a large lake covering most of the area now occupied by the three lakes San José, Buenaventura, and Llama-miku.

The writer was unable to learn the original names of two of the lakes shown on the map. The one in Quebrada Soras marked Calderón had been lost for half a century, until the writer discovered it during the course of his studies in 1935 and named it for Max Calderón, president of the City Council of Potosí, who has aided materially the project of rebuilding the lakes. The name of the remains of a small lake in the Pati-Pati quebrada was also lost; as this lake acts as a basin for diverting the waters of Lake Santa Lucia into the Pati-Pati canal, it is referred to as Lake Santa Lucia Chica.

The Chalviri canal has twice been rerouted. Originally the canal left the Chalviri quebrada by crossing a low place in the morainal ridge shown on the map. Later the canal was rebuilt on a steeper grade and was carried round the end of this moraine into the watershed to the north, this perhaps being part of the betterment program of Chalviri lake and canal executed by General Ortiz de Sotomayor during the years 1613 to 1616. Still later a tunnel was built through the ridge near the location of the original crossing, and a new canal was built to Potosí.

Upkeep of the Lakes

During the earlier days of operation a *lagunero* and a permanent crew of Indian slaves (*mitayos*) kept the dams and aqueducts in repair.[17] Two centuries later, by resolution of February 8, 1784, the work was accomplished through a roll of obligatory service, whereby each person had to contribute his labor on certain days or make a contribution of money. As the lakes filled with sediment, it became a question whether the practice of annual cleaning should be continued or whether the dams should be increased in height to maintain the capacities—a question that has not been resolved to the present day. Since the beginning of the Republic the administration of the lakes and also the distribution of water for domestic purposes have been in charge of various public officials, at first under the government and later under the City of Potosí.

Omiste writes of the annual sums set aside in the municipal budget for repairs and service of the lakes. He also mentions annual allotments of departmental funds to the city for this purpose, though funds seldom materialized because of constant deficit in the depart-

[17] Unpublished work of Vicente Cañete entitled "Guía Histórico."

mental treasury. During 1881 special taxes had to be levied on all consumers of water; for during that year the municipality had turned over its funds to the government for the necessities of the war with Chile. Furthermore, of the sums appropriated for the lakes, probably only a small percentage was actually used for that purpose.

With funds lacking for their proper upkeep, the lakes and canals inevitably deteriorated. A notation in the *Gaceta Municipal* corresponding to May 8, 1886, states that "in the year 1883 a repair to Chalviri dam was made with magnificent result, but unfortunately of short duration because of the poor quality of lime used." A report of the President of the municipality in 1887 states that a commission had inspected the lakes and after mature deliberation had presented an estimate of bolivianos 5596.00 for extensive repairs, but in the absence of funds repair work had been limited to a part of Chalviri dam, which cost bolivianos 862.05. To judge from its patched-up appearance in 1935, many cheap repairs of this sort had been made to Chalviri dam; none were worth their cost, for they merely diverted the leakage from one outlet to another.

The following pertinent excerpts are taken from the report of the municipality to the Minister of the Treasury in 1886.

> Lake San José is in a state of complete ruin at its dam and holds water only in the rainy season and then only for 8 days; Lake Santa Lucia does not exist, being filled with sand, its dam in complete ruin, and its greatest depth not reaching 50 centimeters; the aqueduct of San José loses half of its water in sandy places; Lake San Pablo has so many filtrations that its level is only equal with that of San Ildefonso, making a single lake rather than 2 lakes; San Fernando is full of sand and its dam a complete ruin; Mazuni and Cruciza are in complete ruins; Illimani has nothing remaining save remnants of a wall; Lobato has completely disappeared; Ulistía is in lamentable state, not being able even in the rainy season to impound one meter's depth of water; Pisco-Cocha is out of service, its dam in deterioration and its tunnel completely destroyed; summary, 4 lakes in good service, 7 urgently requiring repairs, 9 completely useless.

In 1935 the lake system was in truly pitiful state. When the writer made his investigation during April of that year, he found only six lakes usable: Chalviri, Muñiza, Planilla, San Sebastian, San Pablo, and San Ildefonso. Of these, Chalviri was losing one-quarter of its waters by filtration under the dam; the dam at Muñiza was leaking so badly as eventually to undermine the structure; the dam at Planilla was in questionable condition to resist full pressure, a portion of its upstream wall "shivering" and "dancing" when waves beat against it; the outlet valve at San Ildefonso could be neither opened nor closed; and there was so much leakage at San Pablo that its level was not more than 15 centimeters above that of San Ildefonso. Also there was so much leakage from the Chalviri canal that placer tin miners made a regular business of utilizing its waters; and although two other lakes, Huacani and San José were fit to impound water,

their canal to Potosí was in such poor condition that no water arrived closer than 4 kilometers from the city.

Rebuilding of the Lakes

Appropriations large and small, special efforts on the part of the small miners and the Compañia Minera Unificada de Potosí, which represents 90 per cent of the mining interests of the Cerro, action of the municipal authorities, clamor of the pueblo had been without result; political differences, petty jealousies, and lack of understanding made any constructive effort for betterment well-nigh impossible. In 1934 the Compañia Unificada decided to safeguard its own interests by constructing an independent water supply, building a dam to impound 1,000,000 metric tons of water at Lacka Chaka, and laying 14 kilometers of pipe line to convey this water to its mill below the city.

Scant rainfall during the summer months of 1935 pointed to a crisis at hand. Even with the new lake in service there would not be enough water to supply even a greatly curtailed ration

Fig. 21—Lakes Llama-miku, Buenaventura, and San José, before rebuilding. Compare Figure 24.

Fig. 22—Lakes in lower San Sebastian quebrada. Left to right Mufia, San Lázaro (extinct), Planilla, and San Sebastian.

Fig. 23—Dam of the sediment-filled lake San Lázaro.

FIG. 24—Lakes Llama-miku, Buenaventura, and San José, after rebuilding. Compare Figure 21.

FIG. 25—Lake San Pablo (front) and Lake San Ildefonso, with its small chapel on the dam (rear). Compare Figure 15.

FIG. 26—Lake San Fernando before reconstruction.

throughout the year. At this point Dr. Mauricio Hochschild, head of the Compañia Unificada, offered the services of his engineering department for a study of the lakes. He also contributed toward the costs of reconstruction, met in part by an appropriation from the central government at La Paz. In September a construction force of 800 was set to work. It was indeed fortunate that the arrangements were completed in time to prepare 24 lakes for impounding water during the rainy season of 1936. Little precipitation actually fell during this summer—10.7 centimeters in January, 8.6 centimeters in February, 3.9 centimeters in March: a total of 23.2 centimeters, or 35 per cent of normal—and there would have been a severe water shortage throughout the year had the lakes not been refunctioning. As matters stand, there is enough water in the lakes at this time (June, 1936) to carry through to the next rainy season provided that care is used in distributing it.

The rebuilding of the lakes of Potosí involved the following operations: the construction of a new dam at Lake Chalviri and

the repair of the old dams or the construction of new ones, as necessary, at the other lakes; the installing of new outlet pipes and adequate spillways at all lakes; the rebuilding of all the aqueducts; the reëstablishing of the lake and canal "lost" in the Quebrada Soras; the rebuilding of the outlet tunnels of Lakes Providencia and Pisco-Cocha, which had caved in; the draining of swampy meadows in the quebradas, where

FIG. 27—Lake Atocha in the Pati-Pati Quebrada.

the waters spread out and evaporated and also became contaminated; the building of some thirty kilometers of motor roads to provide access to the lakes, which, except for San Ildefonso, formerly had been reached only by mule trails; the provision of houses for custodians at the principal groups of lakes; the construction of new intake boxes and iron pipe lines for making use of the springs of Pichincha as potable water supply for the city.

The main part of the operations for improving weak features of the old Spanish construction was directed toward three ends. The early dams had not been carried down to an adequate foundation, many being only 60 centimeters or less below the original surface. As a result, loss of water beneath the dams was heavy: filtration of as much as 80 liters a second has been reported at Chalviri in years when the lake was full. Two methods were used for rendering such dams more watertight. Where the lake was empty, excavation upstream of the dam was carried down one meter within rock or good clay, and a new, impervious masonry wall was built up beside the old dam from this depth. This was the procedure at Lakes Atocha and Ulistía. Where the lake contained water that could not be emptied without interrupting the water supply of the city, as at Chalviri, the new, impervious wall was carried into rock downstream of the old dam, and filling on both sides of the wall gave it support.

The old outlet valves (*compuertas*) were crude and inadequate. Most of them could be neither completely opened nor completely closed, and at many of the lakes they had been removed or stolen. The *compuerta* was indeed the most vulnerable feature of the old Spanish construction. The Spaniards had used a large timber placed vertically within a well and reaching down to an outlet tunnel through

FIG. 28—Lake Providencia, highest of the lakes of Potosí, lies amid snow and cloud and can be reached only on foot.

the dam at its lowest point. A large beam was fastened to this timber at the top for raising or lowering it. The timber fitted into a small aperture within the outlet tunnel and thus could be adjusted to control the flow of water. Later this construction was replaced by an inverted cone of bronze attached to an iron rod or chain that could be raised or lowered from the top, to fit into a stone perforated in the same way. This delicate apparatus failed to function whenever the outlet aperture became blocked with stones or sand, and this was an inevitable occurrence. Efforts to remove the obstruction probably damaged the masonry of the outlet passages.

To provide a proper modern outlet, the old passages through the dams were cleaned out, and 12-inch iron pipe was laid and concreted within these passages. A barrel-shaped screen was placed at the upstream end of each pipe outlet as protection against clogging by stones. A gate valve was installed just below the dam and placed under lock so that the Indians of the region might not operate it to furnish wet pasture for their animals, as they had been accustomed to do with the old valves. Most of the old dams were without adequate spillways—a reason for the washing away of dams in floods.

The lakes now have a total capacity of about six and one-half million metric tons, as Table I shows (p. 541).

One of the reasons why it had been impossible to secure concerted effort for repairing the lakes was the fact that their ownership has never been definitely determined. They were built with some four million bolivianos provided by the miners and the labor of 20,000 Indians furnished by the Spanish crown. As time passed, the successors of the original miners represented by the large and small

FIG. 29—Old Caja del Agua. Above the entrance door are the words: "Año 1775—El Señor Gobernador do Jaime Saint Just con el Ilustre Cabildo hicieron esta obra, con los fondos pios de esta Villa, siendo Procurador . . ."

mining companies of today claimed the lakes by virtue of these disbursements of their predecessors. The City of Potosí likewise claimed the lakes as the successor to the rights of the Spanish crown. The mining companies were wont to deny this claim on the ground that the goods of the crown could not have passed to the city at the birth of the Bolivian republic because the city as such did not exist at that time but was created some years later by the constitution of 1839.

The ownership of the lakes is still in doubt. The Compañia Unificada has permanently relinquished its claims to this water-supply system in consideration of being allowed the use of the three lakes Lobato, Ulistía, and Pisco-Cocha for a term of 50 years. The claim of the small miners still stands.

POTOSI DURING DRY YEARS

Throughout all of Potosí's history there have been dry years. The normal rainfall, amounting to about 65 centimeters at Potosí and somewhat more at the lakes, is more than doubly sufficient to fill the lakes in summer, and it is likely that during the early colonial days, when the entire system of lakes and aqueducts was in good service, water was held over from year to year. However, by the

latter half of the nineteenth century the lakes were in such poor condition that dry years were acutely felt. A municipal ordinance of March 13, 1878, decrees economy of water because of scarcity of rain in this year. An ordinance of March 31, 1885, limits water to the city *pilas* (hydrants for public use) because of the small quantity of water in the lakes—this being at the beginning of the dry season. The ordinance of May 14, 1892, implies low water, and that of February 13, 1897, devises ways and means for "passing through the abnormal conditions in which we find ourselves."

A number of resolutions dated late in the dry seasons of various years do not necessarily mean drought, since the water might have been wasted by careless administration. Among these are ordinances of November 20, 1909, and October 21, 1915. However, the resolution of August 26, 1916, cutting off water in the Ribera entirely from September 1 to the end of the year is a drastic measure that could have been necessary only during a dry year. During 1924 there was also shortage of water, though there are indications that in that year the lakes were in urgent need of repairs. During 1929 rainfall amounted to only 50 centimeters, or about 77 per cent of normal. During 1935 rainfall was somewhat low, and during 1936 exceptionally low.

There is a rather suggestive periodicity in these dates: between 1878, 1885, and 1892 are two intervals of 7 years each; between 1909 and 1915–1916 the same interval; between 1929 and 1935–1936 the same 7-year interval. It may be noted that the dry year 1929 fell about midway between the two wet years 1925 and 1932 of the South American west coast, when the southward-flowing El Niño Current replaced the normal northward-flowing Humboldt Current. The dry years 1935 and 1936 fall midway between the wet year 1932 and the year 1939, when the west-coast current is expected to reverse its flow again. Another dry year in 1937 would be a real calamity for the region; for the underground water resources have been much depleted by the successive dry years 1935 and 1936. However, Indians who predicted dry summers for both 1935 and 1936 and who arranged their planting programs according to this prediction expect a fairly wet year in 1937. This would be in harmony with a 7-year cycle, more humid conditions being indicated as the year 1939 is approached.

Looking into the Future

Potosí, however, should not want for water in 1937. No longer will it be necessary to cut off or even to curtail the supply to the mining industry and thus cause unemployment and distress, or to limit potable water for homes to three hours in the morning or less; no longer will the streets of Potosí be in darkness because of lack of

water for power at its lighting plant or the city be without a sewerage system because of lack of water to operate it.

Already the Compañia Unificada has increased its capacity from 400 metric tons of tin ores treated a day to 800 metric tons, and further increase is under consideration. As this company is increasing its pay roll, so is Potosí's population increasing, and its housing facilities being extended.

As for the lakes that have been so intimately linked with the fortunes of the city, it is not likely that they will be permitted to fall into ruin again. The organization that rebuilt them is under obligation to maintain them until 1939, at which time they will be returned to the municipal authorities, when we may hope that a roused public interest will see to their preservation.

GALICIA: A LITTLE-KNOWN CORNER OF SPAIN*

E. H. G. Dobby

GALICIA has long been a dark region of the Iberian Peninsula, least known of little-known Spain. Spaniards have had slight interest in clarifying ideas about that corner of their country. Galicia has been isolated from its surroundings and cut off from adjacent cultural influences. Although it would be too much to say that Spain has turned its back on Galicia, it may be justly asserted that Galicia has always faced the sea and that the most important modern influences affecting it have come from that direction. It might well be called the "Brittany" of Spain. No comparison can exist between the arid plains of Castile and the dank moors of Galicia, and few points of view could be common to people brought up under those contrasting conditions.

On all but one side Galicia is well demarcated physically. Those who travel to it on the meseta may be impressed by recent alluvial deposits in the Douro plains and by the comparatively small area where old rocks show at the surface. But in Galicia the peneplained meseta comes down to the sea, and its granites or metamorphosed schists show everywhere. In this respect Galicia resembles northern Portugal, but the political division between the two countries has been so jealously preserved and the economic channels have been so deeply etched in new directions that this arbitrary boundary to the south of Galicia is no less strongly marked than the physical differences that act as limits on other sides.

A Granite Block

Galicia is a granite block with irregularly distributed schists of great geological age, a rhomboid uniformly high and sloping gently coastward from about 1000 meters in the southeast corner. Sweeping plains at about 400 meters predominate, and the coast is invariably cliffed; coastal plains are exceptional and limited in extent; the 100-meter contour remains always within a short distance of the sea. Relict forms indicate an old system now so advanced in age that it reveals no clear idea of what its relief was, especially when there is the added difficulty that no detailed topographical survey has yet been made in the province. To the east and southeast Galicia

*This regional study follows the author's general article on the fundamental "Agrarian Problems in Spain" that appeared in the April number of the *Geographical Review*. Other regional studies by Mr. Dobby are "The Ebro Delta," *Geogr. Journ.*, Vol. 87, 1936, pp. 455–469 (noted in this number of the *Review*), and "Economic Geography of the Port Wine Region," *Econ. Geogr.*, Vol. 12, 1936, pp. 311–323.—Edit. Note.

The author wishes to express his thanks to Professor Antonio Pastor and to Sr. Ramón Otero Pedrayo for their guidance in this region, which presents so many difficulties to the inquirer.

ends where the block form loses its sharp definition: roughly on a north-to-south line just west of Fonsagrada, where the younger Cambrian strata appear as a long succession of valleys and high mountains reflecting the north-to-south structure. Lines of communication dead-end frequently on meeting this country of Asturias and León, and, although Galicia has been called the "Switzerland" of Spain, it bears little resemblance to that country, being definitely nonmountainous. To the southeast a complex country of high blocks and ridges marks where the Cantabrian Mountains break up the clear meseta form before finally giving way to the inner alluvial plains of León.

The most emphatic influence on the shaping of the Galician block has been a severe shattering in two distinct directions. The first resulted in a series of faults or lines of weakness in a north-to-south direction, probably associated with the formation of the Cantabrian Mountains, seen in the direction of the west coast, in a pronounced rift running from Túy to Padrón, in coastal lines round El Ferrol and Ortigueira, and in some low ridges like that of El Faro. More striking than this line of fractures is the second, of roughly northeast-to-southwest trend, which much of the drainage has followed. The northwest coast between Capes Toriñana and De los Aguillones, the rias of the west coast and the rivers that flow into them, the Sil-lower Miño river system, the short streams that run into the Cantabrian Sea—all these take their origin in this second line of shattering. To the coast line the grain of the relief is oblique and thereby contrasts with the parallelism typical of the Mediterranean coasts of the peninsula.

Rounded granite domes typify the setting, and the granites, the ubiquitous granites, enter, as it were, into the very life of the people, reflected, for instance, in the kind of dwellings they have and their special skill in masonry. Broadly speaking, rocks of Cambrian and later types lie east of a line from Ribadeo southward to the Sil, with a riblike outlier of schist running north to south from a point between Ortigueira and Vivero without serious interruption to the latitude of Monforte. Between this outlier and the main mass of post-Cambrian to the east stand the granite plateaus of Lugo, covered, in the Tierra Llana, with the largest patch of fluvial detritus in the region, a coarse bed of sands and granite boulders, boggy in many places.

The indented ria coast brings marine influence well into the Galician block. The rias of the northeast, Rías Altas, are distinct from those of the west, Rías Bajas, in many respects: they are much smaller, straighter, and less abrupt in the outline of their sections; often they have sand accumulations at their mouths as a result of a steady westward sea drift. The Rías Bajas are large and their open mouths are marked by a rocky mass, associated undoubtedly with the north-to-

south fracture line, which stands above water as a string of islands blocking the entrance or lies barely submerged—a perpetual danger to shipping. Both types of ria (Fig. 20) afford good shelter from the stormy seas in which they are set, but entrance is not easy, especially in the Rías Bajas. That is the *raison d'être* of Vigo, which stands on a ria whose entry is less dangerous, and Coruña, whose seaward entry is clear and simple.

FIG. 1—Sketch map of Galicia showing places mentioned in the text. Scale approximately 1 : 3,000,000.

No effects of glaciation occur in Galicia except on the extreme heights of the east in small, strictly local patches. The influence of ice has been almost negligible, so that the valley sections take on only variants of the V shape.

Rivers normally follow the half-erased lines of old relief systems. In the interior, on the low plateaus and moors, the rivers have the characteristics of great age; the valley forms are open and wide, the watersheds are vaguely defined, and marshy stretches abound. In the upper Miño this feature is especially marked. The small range of water levels has created a response in the curious type of water mill used, its driving wheel placed horizontally to obviate the need for any height of water greater than about half a meter. Toward the coasts river evolution has been complicated by a geologically recent change of levels, probably associated with the sinking of a block off the west coast, which has rejuvenated the fluvial system on lines disconnected with the previous ones. Few of the rivers have any terraces; they are deeply cut in their lower reaches; and many of them have rapids close to their mouths. Their profiles are far from being in equilibrium with present relief; for active erosion continues in their lower sections, in complete contrast with the sluggish upper reaches. The lake of Antela, near Ginzo de Limia, for example, shows an earlier stage of what the Tierra Llana of the upper Miño

FIG. 2—Mugia, near Finisterre. Fishing is the sole occupation for the men; the women make lace in their homes.

now is. The fertile plains of Támega and Monterrey lie in old marshy plains recently dried out by revived drainage. The Sil and the lower Miño are deeply etched in precipitous gorges in complete contrast with the plateau country through which they pass, and the railway journey along the gorges gives no idea whatsoever of the true character of inner Galicia.

SPAIN'S RAINY PROVINCE

Despite the poverty of data, it is apparent enough that the weather of Galicia marks it off in yet another way from the rest of Spain. The southeast boundary of the province closely coincides with a line north of which annual evaporation is less than annual rainfall. Nowhere else in Spain, except along the Cantabrian-Pyrenean heights, does that occur, and it forms the chief disagreeable fact about Galicia for most Spaniards. The weather is conditioned by a constant play of Atlantic cyclones upon this corner of the peninsula as they sweep northeastward. The general drift of winds follows that line too, but the details are highly variable and changeable, as in all cyclonic zones. With this interacts the emphatic continental climate of the Iberian meseta, where winter anticyclones and summer cyclones assert themselves for protracted periods, though the high mountain barrier of León and Zamora gives some protection, especially from that bitterly cold wind that blows from the meseta in winter.

Galicia is Spain's rainy province. For the last decade a small area about Pontevedra, whose heights rise sharply from the coast, has shown an annual average rainfall of more than 2000 millimeters. A belt about 30 miles in width along the coast receives regularly more than 1000 millimeters a year, leaving the central high plain with 700 to 1000 millimeters. The rain falls in long showers of fine drops.

FIG. 3—Typical coast scene near Coruña, where the Galician peneplain reaches the sea in unbroken cliffs.

It can be seen sweeping in from the sea like a Scottish mist and passing in procession over the high plains. It is very evenly distributed throughout the year. Marked cloudiness is one of the factors maintaining a low rate of evaporation.

In addition to persistent humidity, the climate is mild. Both daily and seasonal temperatures show only small variations. January has temperatures regularly above freezing (and above 10° C. for most of the region); in July 20° C. is typical. The inner plateau naturally has a greater range of temperatures than the coast. The heights of the extreme east and south retain snow into the summer. The humid mild winters of the rias, on the other hand, make nearly the whole year a growing period. The interior differs much within itself; for there is great contrast between the wind-swept plains round Lugo and the deep-cut protected valleys of Orense. On these plains the summers are rarely more than mild; Orense's valleys have a confined heat that permits all types of warmth-loving plants, from vines to magnolias. Except for the insular coasts, exposure is the chief local influence on the weather, and the long period when mist fills the deeper valleys suggests why the hamlets avoid such sites. Low altitude prevents snows from being of long duration even in the interior plains.

Climatically, four broad types can be suggested: the very rainy, suave temperatures of the western rias; the mild, moist, storm-swept coast of the north and northeast; the exposed, bleak inner plateau, with its variants of protected valleys to the south; and the mountain climates of the landward margin merging into Asturias and León.

A Green Landscape

In Galicia, in contrast with the sun-baked meseta, the natural vegetation covers the landscape with tones of green; rarely does the

bare soil or the rock lie naked at the surface. Weather-beaten blocks of granite that show through the soil in so many places carry mosses and lichens to smooth their lines. In the 30-mile coastal zone of higher rainfall mentioned above conifers grow and, ignoring usual botanical laws, put on two layers of branches, or two rings a year. The interior, more exposed, less humid, and colder in winter, carries much deciduous forest of oak and chestnut, though the birch must now be considered as the typical tree of inner Galicia, since timber trees have been mostly cut out for commercial purposes. The chestnut was once particularly common and takes important place in folklore references, but the tree has suffered from the plague that has exterminated many forests without man's finding any remedy. Continuous natural forests of any importance are now confined to the isolated valleys toward the east, protected by inaccessibility. Elsewhere, woods are in small patches, and what were forests are now heaths. In the province of Pontevedra considerable reforestation is going on, especially with the Douglas pine, though the native pine commonest in the coastal zone is the black pine.

So thoroughly have forests been cut down that now the bush and shrub vegetation is the most important in the plant landscape. All varieties of heath and gorse found in southwestern England occur in Galicia in more luscious forms. Heather itself has little importance, but gorse develops to large size and has become an integral part of the rural economy as cattle feed. Numerous varieties of *Erica*, *Ulex*, and *Genista* are found, mixed, in the warmer parts, with Mediterranean plants of the laurel and myrtle type. Ashes and willows line the meadowlands of the flatter valley bottoms, and reeds follow the streams. Elms are numerous toward the slow-growing interior, adding there a touch of the tranquil English landscape. Warm valleys in Orense permit the cork oak, which from there stretches southward uniformly into Portugal, but the production of cork in Orense does not reach commercial proportions. Olives are now found as degenerate specimens in the southern valleys, a mere remnant of their former importance.

Podsol Soils

High humidity, granitic parent material, and dense heath vegetation create circumstances suitable for podsol formation, and so it is not surprising that the Galician soil is most definitely of the podsol type. The parent rock has an acidic base, the heath vegetation and its sour humus accentuate acidity, and the high rainfall gives the final condition for that excessive leaching common to podsols. Upon the metamorphosed schists finely divided soils are found, with clay elements and flaky bodies, but over the greater part of the region the soil is on a sand base and is very poor in the limy elements essential

for fertility. Great stretches of the inner plateau show coarse beds of pebbles at the surface; in many places the weathered face of rock can be seen, and the shallowness of the soil is revealed; and the rapid runoff of meteoric waters makes the surface too dry for vegetation if as many as four days pass without a shower. Over most of the area soil has definitely disintegrated *in situ*; the broader valley

FIG. 4—Landscape of the granite country in northeastern Galicia, showing gorse patches, cleared in places for a crop of rye, and the net of granite-walled lanes.

bottoms, where not too immature, carry fluvial accumulations of finer transported elements. The long fault valley that runs from Túy to Padrón is especially noted for its better and deeper soils and has permitted intense cultivation to a degree little known elsewhere in the region. Round Monforte, where a curious Miocenic outlier creates an interesting geological problem, the soil becomes a brown marl, upon which vines flourish exceptionally.

THE LANDSCAPE TYPES

There are three clear types of landscape in Galicia: inner plateau, peripheral valleys, and the coast.

Although the words "Sierra" and "Mountain" appear frequently on the maps, there are few true mountains, and the relief shows no sharp variations. The interior is an undulating area at a general level of 400 meters, bulging with rounded lichen-covered granite rocks and threaded by many brooks and streams of indecisive drainage. Dense masses of green heath are continuous over the countryside, broken by clumps of birches, occasional oaks, and remnants of old chestnut woods. The wide horizon develops its suave profiles through unfolding blue mists; bushes and trees slant at a permanent angle under the sweep of persistent winds; the dark pines sway in a perpetual

sigh. Paths cover the landscape as vaguely as the streams. In every slight hollow there is a house behind its clump of trees. Strangely balanced rocks are not uncommon and give rise to the usual Celtic stories of enchanted stones.

The valleys of the rejuvenated landscape on the edge of the main land mass are less exposed and better for cultivation. The soils are still sandy, so that after every shower the shine of mica fragments comes from the earth, but the proportion of finer elements is higher than in the *chaos* or moors above. To the south the deep valleys are lined with vinevards of tall vines that need supports to keep them erect. Here the paths, under the constant passage of heavy oxcarts, sink deep into the sandy ways and are almost invisible behind their hedges. Mosses cover all exposed stones; reeds mask the many small mills down by the streams.

The coast is in complete contrast. There the Atlantic, whipped by an uninterrupted series of cyclones, frets on a rock-bound coast and lashes at the barriers to the rias. Jagged points conceal the sandy beaches that run between. The cliff tops—and most of the coast is high—are too wind-swept to carry more than a few rock plants, and cultivation of the almost virgin sand is impossible until the sheltered interior is reached. To each open bay there is a rambling stone fishing village, which in the ria country will be an agricultural village as well.

Agriculture: Rye, Maize, Vine

Agricultural distributions in Galicia must necessarily be discussed on general lines because no survey has been made. The facts used here arise partly from direct observation in the field and partly from detailed talks with the state agricultural engineers to be found in every provincial capital.

The basis of Galician agriculture is rye, to which the whole of the central plateau, Lugo, and much of Orense are devoted. Rye responds well to the poor acid soil and the bleak country where the heavy cloud cover makes a wheat crop uncertain. The greater part of Spanish rye is produced upon the Galician *chaos*, and rye bread has become associated with Gallegos. Rye straw is used as fodder, as stabling for the cattle, and as house thatch, though the practice of thatching is on the wane. Rye is not an intensive production except in highly favored and protected parts of the interior, where it alternates with potatoes and an occasional sowing of Galician cabbage that remains in the ground for two years. Over the greater part of the region a "snatch" crop of rye is taken at intervals of six to ten years. The heath vegetation is mowed down and the surface left for several summer months. The upper six inches or so of soil, tightly matted with *tojo* or gorse roots, is then cut up in sods and stood

on edge to dry out, when it is burned. The ash, which forms a fertilizer and counteractant to the general acidity, is plowed in and the rye sown. After the harvest, which generally takes place in early July but may be delayed, in exposed areas, to the end of August, *tojo* is sown again, and the land reverts to heath for the interval mentioned. Such is the custom in most of Galicia, especially where, as is very common, the parish possesses communal upland.

North of the central rye zone, round Villalba and in the sandy gravel plain of the Tierra Llana, the potato has taken on special importance and an unusual intensity of production to meet the demands from the city of Coruña and even for export to Madrid and Barcelona. Both rye and potatoes have become staple all over the region and form an important part of the regional diet. Another heavy potato-producing district is the flat land about the Laguna de Antela in the extreme south of the region.

Maize, too, covers a wide area. In fact, Galicia produces two-thirds of Spanish maize, and half of this grows in the province of Pontevedra, in the small but highly productive valleys of the ria country. Subsidiary to this maize zone is another round Las Mariñas of Betanzos and on the inner margins of rias on the northeast coast. Maize is concentrated in Pontevedra, where the dampness and the invariable warmth are especially favorable; two crops a year are frequently grown, though the second may be usable only as green forage. Despite the high rainfall irrigation may be necessary to prevent the drying out that so quickly occurs upon this sandy, unretentive soil. No impressive irrigation works exist, nor are they necessary. Simple leads-off from the streams suffice. The relief would make any more complicated irrigation scheme difficult. Intensive maize production generally finds a limiting altitude at about 300 meters.

Vines suffer from the heavy cloud cover and the high humidity, and choice of aspect is important in the planting of a vineyard. Districts famous for wines are the lower Miño and the Sil. The vines are closely confined to the steep, well drained riverbanks and rarely leave the protection of the gorges for the plateaus above. There are four well known zones: Valdeorras, in the upper Sil; Monforte and the Miño-Sil junction; Ribadavia; and Salvatierra. The Monforte zone spreads out upon the Miocenic marls there. In contrast with usual conditions in other parts of Spain, only the lightest of sandy soils can here be used for the vine, i.e. soils that permit rapid removal of water from about the roots of the plant. Nevertheless, the vegetative growth of the plants is more than the stems can support, and slate or granite posts are provided to hold the branches above the damp ground, or, in modern plantations, wire trellises are put up for the purpose. Excess of moisture and absence of lime cause the grape

FIG. 5—Primitive Galician house. The thatch has been extended with slates; the door is the only opening. The gorse is to be fed to the cattle inside the house.

FIG. 6—Primitive type of *hórreo* (storehouse) on the high plain of Lugo; it is of wicker thatched with rye straw. Chestnuts in the foreground.

FIG. 7—Vineyard in a tributary valley of the Miño; the vines are held up by granite stakes.

FIG. 8—An *eira* near Orense with *hórreos* grouped round it; the rye is threshed, all the villagers helping one another, under the shadow of the typical crucifix.

FIG. 9—Peasant house near Geve with the usual grapevine over it, although vines cannot be grown in the fields.

FIG. 10—Vineyard near Orense showing the granite [illegible] and sticks to support each vine.

—Paso, or seigniorial house, with family shield shrouded in
and the chain, to touch which gave fugitives the protection
nior.

—View in high Pontevedra near Lalin, which still preserves
d character. All the cultivation here is rye.

—Moor landscape east of Sarria, central Lugo.

FIG. 14—A *paso* in the south, with enormous chimney and the distinctive window slits of the lower floor.

FIG. 15—Gorse moor of the interior with the mound of a *castro* in the distance. Margin of the Tierra Llana.

FIG. 16—Site of Celtic encampment, near Friol, in southern Lugo, now cultivated periodically even on the outer fosses.

of Galicia to be thin-skinned, low in sugar content, and extremely acid, with a juice of dark color and little "body." The normal grade of alcohol to wines in Galicia is about eight to nine degrees with five to six degrees of acidity. The Galician abroad commonly adds lemon juice to his wine before he finds it palatable.

Although this sketch of agricultural zones fairly represents the attention given to crops in various parts of Galicia, it must be balanced by remembering that few farms below 800 meters do not have a patch of maize, if only for green fodder. Almost every farmhouse will have a great vine trailing over the doorway or on the sunniest wall. Potatoes are grown everywhere, since they are staple in Galician diet to a greater extent than in the Irish.

The Rural Economy: The Place of Cattle

Fundamentally the Galician farms are almost self-sufficing and self-contained economically. Bread is home-ground from the farm maize in the Rías Bajas and Las Mariñas or from the farm rye. In the eastern sector, which modern influence has hardly reached, women may be seen spinning coarse wool on a distaff while they tend a couple of cows or patiently weaving on a hand loom during the winter evenings. The areas notable for an emphasis on one crop are no less self-sufficing. Their small surplus enters into local commerce solely from a small percentage of farms that pay rent in kind, and it is that small margin that moves from one region to another. Although the peculiar structure of Galician rural economy has protected it from the grave crises that have afflicted the one-crop regions of Spain at various times, even in the best of years Galicia knows much misery among those small farmers who, although aiming at self-sufficiency, have not farms large enough to support them through the year or the money necessary to make up the deficit. On the whole, Galicia does not produce enough to support itself.

The keystone of Galician agriculture is cattle. However small the family patch of land may be, there is one cow. That cow plows the fields and pulls the carts; every year it will give a calf and produce milk, which as butter or cheese is important in the diet. The annual calf, sold at about nine months, yields the only money that many Galician families handle for years on end. This calf has been the real taxpayer for many years, since taxes must be paid in cash. No attention is paid to questions of breeding except near provincial capitals where the government maintains a pedigree bull. The cattle are poor in quality, small, bony, and low in milk production. Two types can be distinguished. On the higher plateaus of the interior, where cattle graze much in the open and the work in the fields is less, animals are small and lighter (about a hundredweight less in

average weight) than those in areas of more intensive agricultural production, in the Rías Bajas and Las Mariñas. Field work there is heavy, and the cattle, when not working, are strictly confined to stables. These stall-fed cattle are heavier, less bony, and give more and fatter milk.

Meadowland is not so common in Galicia as might be supposed.

FIG. 17—Plowing a Gallegan field. Even the youngest members of the family help.

Only in limited areas, by the streams of the damp western valleys, does natural meadow exist. Meadows, strangely enough for so humid a country, normally require artificial watering, for the same reason that maize needs irrigation. The effects of a short drought in Galicia would be serious in the extreme were such provision not made. Meadowland carries a higher value than any other type of agricultural land. Its use is for hay, and only for short periods after cutting do cattle enter the meadows freely. The mainstay of cattle feed, however, is the gorse or *tojo*.

The sale of the calves does not take place at any one season but is spread evenly over the year. Lugo is the focus of Galician cattle movements. A train unique in Spain starts daily from Lugo—a train of some twenty-four cattle trucks, destined for Barcelona for the most part but also for Madrid. No other region knows such a train. This is the chief economic tie of the region with the nation from which most other circumstances isolate it. Less than 10 per cent of the meat-cattle trade is handled through coöperative societies. No coöperative effort at all is put into dairying, largely because the products are destined for strictly home use. Only the district round Villalba produces enough cheese to enter into the Spanish market, chiefly owing to the nearness of Coruña. The production of milk to a farm a day is very small, and the cheeses weigh only four to five

pounds. The cheeses are white, creamy, and bluntly conical in shape; the quality is very variable owing to the rudimentary home methods used in the making, so that there seems no immediate possibility of launching Gallego cheeses upon the market with the success that the Asturias region has had.

Pigs are ubiquitous; they are thin and black and have as few fine points as the Galician cattle. The cutting down of most oak woods, on the one hand, and the loss of chestnut forests due to the plague, on the other, have been serious for pig production, since the fruits of those trees were the fattening foods for the pigs. The larger amount of woodland now in the interior makes Lugo the greatest pig province of the region. The farms must sow some crop especially for maintaining the pigs and generally have to buy feed if they sell the fattened animal. Farms have few pigs, rarely more than two or three. They are slaughtered annually, and the hams are sold if possible, though they are not to the taste of the rest of the peninsula and have only a limited market in the north. The minor flesh is cured or made into sausages to serve as meat food for the whole of the next year. The unpreservable parts are eaten at once as the great feast of the year—often the only occasion on which the family eats fresh meat. The consumption of cured meat even is small, its place being taken by butter and cheese foods.

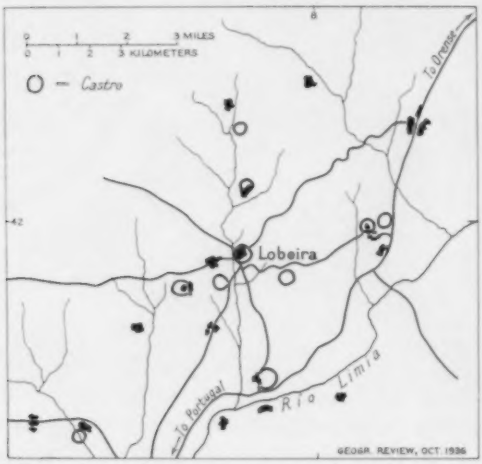

FIG. 18—Map of Lobeira in southern Orense, which illustrates the close relation between the *castros* and the sites of modern hamlets. The dense knot in the center is the village of Lobeira, with *castro*, and radiating lanes across the moors. (From Cuevillas y Lorenzo: Catálogo de Castros Gallegos.)

DISTRIBUTION OF PEOPLE

Only one map, Coello's, of the first half of the nineteenth century, has ever attempted to suggest the distribution of people in this region in any detail, and that is hardly adequate in scale (1 : 200,000) or in date to indicate modern conditions.[1]

[1] The population-density map by J. Dantín Cereceda published in 1925 (see note in *Geogr. Rev.*, Vol. 17, 1927, pp. 491–492), useful as it is, is on a scale of only 1 : 800,000, and a still smaller scale is used by Georg Niemeier in "Untersuchungen über die Streusiedlungen in Spanisch-Galizien," *Ibero-Amerikanisches Archiv*, Vol. 8, 1934, pp. 7–21, map opposite p. 10. Neither map shows the actual facts of distribution. Coello's map, on the other hand, attempts to show each building by a dot.

Of the four provinces making up the region, Pontevedra has the maximum density of 121 a square kilometer—a natural result of its favorable physical circumstances. Lugo has the minimum of 47.5 a square kilometer—a reflection of the harder conditions of life on that inner plateau. Although the density of population is remarkable under the circumstances, the special feature of the population dis-

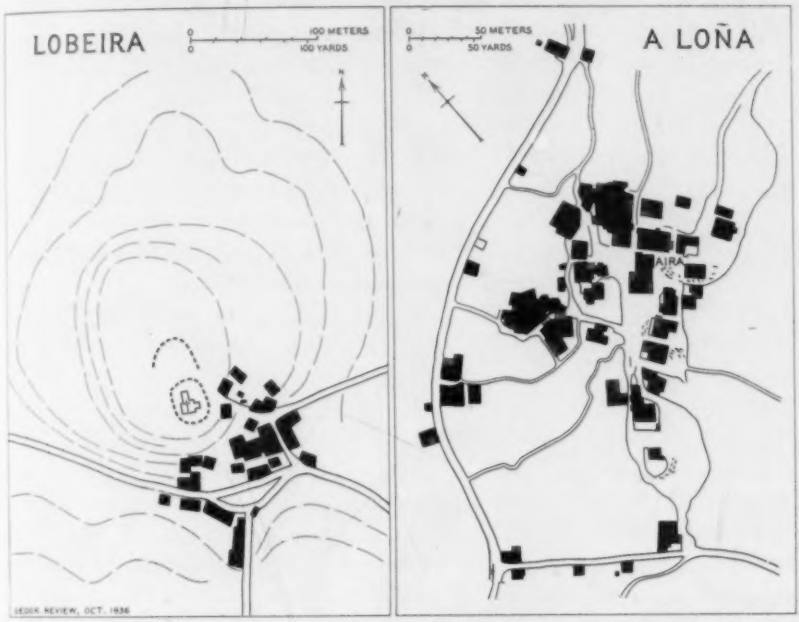

FIG. 19—Layouts of typical *aldeas*. The one, Lobeira, from the extreme south of the region, lies clustered round the descent from an old encampment with its church inside that encampment (form lines are drawn to indicate relief in the absence of an official survey). The other hamlet, A Lofia, in the Melide country of central Lugo, shows the vague form, the many ways, the communal threshing floor, *eira* (*aira*), and the profusion of exterior stairs associated with Gallegan hamlets.

tribution is its dispersion, which is a phenomenon in the peninsula. According to Dantín Cereceda, there is, on an average, one hamlet to 1.1 square kilometers. More than half of the Galician hamlets (54 per cent) have fewer than 50 inhabitants each. In addition 15 per cent of the total population live entirely isolated, in houses that stand alone.[2] This dispersion into lone farms is greatest in Lugo, where 26 per cent of the people live so, and least in Orense, where only 4 per cent of the people live isolated. The areas of denser population are coastal, because there, in addition to the milder condi-

[2] Niemeier interprets the official figures somewhat differently. He gives the settlements of fewer than 5 houses as 6 per cent for the entire region, the percentages for the provinces being: Lugo, 11.3; Coruña, 7.2; Pontevedra, 3.3; Orense, 1.2. The trouble with any academic study of Galician population distribution is that nomenclature is vague and elastically used; no one knows the areas of the political units, not even the local secretaries. The official statistics are devised to show fairly the degree of concentration of the population (the condition characteristic of the greater part of Spain); but they do not show dispersion. One "official" hamlet often contains five or six. The actual facts of distribution can be presented only when a survey has been made.

tions, fishing increases the means of livelihood. Even within this zone denser patches are indicated in Las Mariñas and on the inner fringes of the western rias. In the interior the edges overlooking the gorges of the Miño and Sil are favored areas. The sedimentary basin of Monforte likewise stands out as a zone of dense population away from the attraction of the Miño-Sil Valley.

The scattered houses and their occupants are not at once noticeable in the landscape. The rounded hogbacks of granite are more prominent, and the serried regularity of granite field walls or bramble hedges or hedges of piled sods. Yet the people are there, as may be seen on Sundays when they gather together round the tiny church. "Behind each hedge, there is a Gallego; behind each rock, a house." The dark tone of the houses without whitewash, the commonness of wall lichens and roof mosses combine to camouflage the houses, and in this moist climate, where clouds prevail and mists conceal, the domestic smoke is lost in the horizon. The cultural focus of each hamlet is the church, which, without any special concentration of houses about it, draws upon perhaps a dozen house groups too small to merit the name "hamlet." The people of these groups are often closely related by family. The unit is the parish, yet each group has its place name, so that the profusion of names is overwhelming. The parishes, cut across and unrecognized by other legal units, persist because of the considerable communal assistance they give. At the harvest season outside labor is not to be obtained, even if the owner-farmer could afford it. It is customary for all members of a parish to thresh for one another, or unleaf the maize. In the vine area all help at the picking. The reality of the parish unit appears stronger toward the interior, where communal heaths are tilled and grazed in rotation by members of the same parish. The unit has been ignored administratively because it is so small and differs in type from the normal Spanish form, but its intimate relation with the lives of the people gives it more real value than other arbitrary units. Communal feeling in parishes should afford a definite base for that coöperation that must develop if either the cattle breeding, dairy farming, or other agricultural activity is to be carried beyond the haphazard, inefficient standards of Galicia today.

Strikingly enough, individual hamlets seem to favor the sites of the barrows and earthworks that are found with astonishing frequency over the whole region. Remains of these earthworks, *los castros*, favor slight elevations; many of them appear to have been built up with two or three fosses, which now show as gentle furrows in the ground. At any rate, the richness of Galician *castros* has yet to be explored. The modern church may stand on the outer slope or the hamlet arrange itself along a path from the *castro* down to the stream near at hand. This close relationship of present popula-

tion to the *castros* shows how little the human layout of Galicia has changed during many centuries.

In the human geography of Galicia one of the most remarkable facts is the effect of a fault line near the west coast. From about Negreira, near Santiago, to Túy, on the Miño, runs a clear valley line that forms the only continuous break in the whole Galician meseta. Structural weakness is obvious, but no one stream now covers

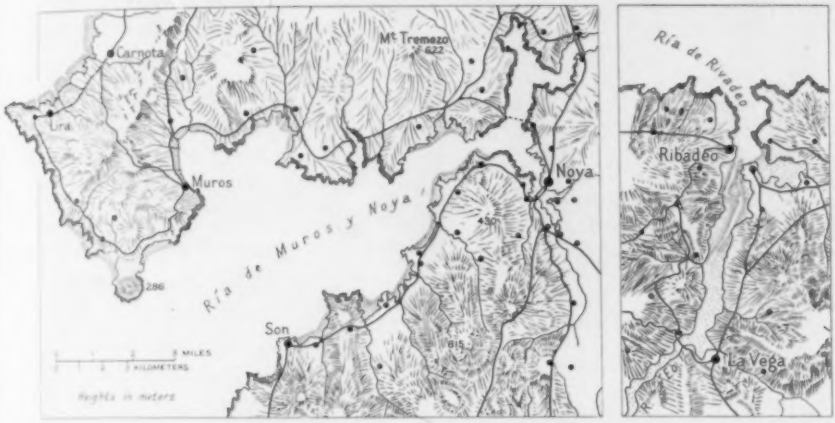

FIG. 20—The map on the left is of the Ría de Múros y Noya, into which discharges the Río Tambre; the map on the right is of the Ría Rivadeo, on the border between Galicia and Asturias. The maps show contrasts in form and proportion between typical rias of the western and northern coasts of Galicia. On the other hand there are similarities in the distribution of population nuclei: note the chief villages at the head and on the inner extremes of both arms of the rias. Scale approximately 1 : 275,000. (After Domingo Fontan's map of Galicia, 1 : 100,000, 1845.)

the length of the valley, which forms the landward limit of most of the rias. In this valley a dense population has concentrated, together with the railway to Santiago and the principal modern roads. This Pontevedra corridor, as it may be called, has deep soils, ample rain, plenty of small streams from the plateau for occasional irrigation and a line of springs along it. Its northern limit probably influenced the choice of the site of Santiago, the ancient cultural and religious center, so placed as to be readily approached from all parts of the Galician meseta and, along this corridor, from the rich ria country and Portugal. It was undoubtedly the communications afforded by this corridor that helped make the Rías Bajas assume importance in Galician economy; whereas the ria country of the northeast, without any landward facilities of approach, isolated from the rest of Galicia, and cut off from the Asturias, has remained much more backward economically.

Within each ria the population arranges itself peripheral to the land masses, which are high, steeply flanked, and wind-swept. Three nucleuses are typically found in all rias, whether of the west or of the north. One is at the inner end, as communication focus for the

FIG. 21—A fishing boat of the Rías Bajas with the Gallego sail, a type that closely resembles the Portuguese.

interior; the other two are situated on the seaward arms, and they are primarily interested in maritime affairs. In both ria countries labor is amphibious, and fishing alternates with cultivation. Only along the northwest coast, from Finisterre to De los Aguillones, is fishing a full-time occupation, and that arises from the extreme poverty and exposure of the cliffs round about, an outlier, as it were, of the main Galician meseta. On that coast subsidiary work to steady the erratic nature of fishing is done by women who make lace by hand by the pillow-and-spool method made famous by the Maltese. This home industry is the only one of its kind in northern Spain The women now use cotton thread from France, though originally the material was flax from the interior. The main market for the finished lace is South America. So cheaply do the women work that, if it were not for duties, the prices for narrow lace would be no more than for the machine product.

The fish of the Galician coast are those common to western European waters together with sardines and anchovies. For these last a string of canning factories lines the whole coast and concentrates especially in the Rías Bajas. Canning is the one real industrial activity of the region. It is not a full-time job in most cases, even though, besides the sardines and anchovies, much shellfish is canned. This coast is ideal for crustaceans and all types of bivalves; both are often sent alive in tanks to the provincial capitals of Spain, where the consumption of such *apéritifs* is greater proportionally than in any other European country. Considerable cod is dried and finds a ready market in Castile, but always there are the impediments of distance and the ineffective system of communication.

COMMUNICATIONS

The parishes are united by a complex net of meandering unmetaled ways, hedged and nearly impassable after rain. The self-

subsisting economy has made the volume of transport small, so that communications have remained primitive and undeveloped. It can justly be asserted that the railway came to Galicia before roads did: it also remained inefficient and still serves only an average of 19 meters to a square kilometer of the region. Now motor transport has come, with its advantages of flexibility and initial cheapness, but it is seriously handicapped by the lack of modern roads. The rural cart maintains its importance for transport, since its heavy, boatlike construction makes it unbeatable upon the country lanes. The Galician cart has two solid wheels of wood, which revolve with such friction that its coming is heralded from afar by the high-pitched howl of the axles. This friction serves as brake over the rough surface and puts an inconsiderable strain on the cows that placidly plod in front.

FIG. 22—Emigration of the males compels the women to do heavy work, such as porterage.

Communications within Galicia are defective enough. The main Coruña-Madrid railway does not find the rise from the coast to the Lugo meseta easy and, after the central plateau is left behind at Monforte, must pass along the side of the deep Sil canyon through the southwestern mountains before reaching the easier plains of Astorga and León. At Monforte the line divides, and one branch follows the Miño to Túy before entering the Pontevedra corridor on the way to Vigo and Santiago. Local politics have always hindered the completion of this route by linking Santiago and Coruña. No line goes along the north coast because that coast presents most serious engineering difficulties. Much fish is sent daily to Madrid from Coruña by motor. Yet the region lags behind the average conditions of public motor traffic in Spain. Far more important for Galicia is the fact that international steamship lines regularly pass its coasts. As this is a key position for the Bay of Biscay, and as the coast of Portugal presents no harbor until Lisbon is reached, Vigo and Coruña have grown to importance on the strength of their good harbors and their emigrant traffic. They have little import or export trade, because of the lack of commercial products and small buying power: they are ports without hinterland.

These international ports of call give Galicia an oversea outlook and make the region conscious of certain economic anomalies that have reached such a pitch that they have become the basis for a movement advocating separation from the rest of Spain. Steamers touching at the ports carry grain at prices below the level of those obtaining anywhere in Spain, and even maize, which Galicia produces more economically than other parts of the country, has costs of production beyond any possibility of competing with maize from South America. Although this region is the largest producer of maize, it needs more as economic interest increasingly centers on cattle conditioned for market on an intensive maize diet. Maize, in fact, is less and less used for human consumption as Galicia feels a gradual rise in the standard of living due, predominantly, to the return of the emigrants. Cheap maize is necessary to maintain low cattle costs; but foreign maize cannot be imported, since Spanish duties, designed to protect the cereal growers of Castile, prohibit completely any cereal importation. Gallegos are increasingly aware that the optimum for the region could be reached by complete concentration on cattle breeding and dairy farming. Lands at present in uneconomic cereals could be put to pastures and forage crops; then, by allowing lower-priced foreign maizes to be imported for fattening, an exportation of live cattle could be made. It is a fact that rye costs three times more to produce in Galicia than wheat in Castile.

Division of Property and Its Effects

It has been pointed out above that this region has a population exceptionally dense for the peninsula: only in rich agricultural regions like Valencia and Granada are such densities equaled. The pressure on the land becomes enormous and creates serious agrarian problems. Everyone owns land in Galicia. There is no problem of breaking up the land and giving it to the poor, the problem over most of the peninsula. Even the professional classes own land and concern themselves intimately with the cultivation. "Gallegos never use handkerchiefs; they till them" is a succinct expression of the poverty of Galicia and the minute sizes of the landholdings. Statistics are unobtainable owing to the lack of a survey, but the following information on the size of holdings was deduced from rural land taxes:

In the province of Coruña the average size of a farm is 3.2 hectares. Seventy-five per cent of the population own farms smaller than the average; 72 per cent have farms smaller than 3 hectares, the average size being 1.8 hectares; 66 per cent of the area is divided among 47 per cent of the people in farms of an average area less than 1 hectare; 11 per cent of the population own 32 per cent of the land in farms of 7 to 20 hectares.

In Lugo the average size of a farm is 5.8 hectares. Seventy-seven per cent of the population own farms smaller than the average; 48 per cent have farms smaller

than 3 hectares, the average size being 1.7 hectares; 12 per cent of the population own 33 per cent of the land in farms of 10 to 25 hectares.

In Pontevedra the average size of a farm is 2.1 hectares, but 77 per cent of the farms are smaller than this average. Eighty-three per cent of the people have rural properties averaging 1.6 hectares in area; 16 per cent of the land is held by 48 per cent of the population in units smaller than 1 hectare and averaging two-thirds of a hectare.

Property is pulverized in the province of Pontevedra to an extent that can hardly be equaled in other parts of Europe. The largest properties of the region are found in the interior, and most of these farms include much bleak moorland. What can be the value of a farm of 12 hectares if conditions are such that only one sowing can be made upon it in a dozen years?

As a result of pressure upon the land emigration has been part of Galician life for many years. Sometimes the emigration is for long periods of 10 to 20 years, to accumulate capital. At other times emigration is seasonal, a trip to the sugar plantations of Cuba, the coffee country of Brazil, the wheat or maize fields of Argentina. In fact, it is difficult to find an adult Gallego who has never set foot in South America. In Galician literature the theme of emigration and its emotional effects constantly recurs. Many families depended on money sent home to them from abroad to eke out the deficient production of their farms. Now that newer countries close their doors to the casual foreigner and control the export of money, the rural distress in Galicia has become extremely serious but passes unnoticed because it is scattered. Some relief is found by a few weeks' migration to the wheat harvest in Castile or the grape picking in Aragon, but that relief is small because those other regions of central Spain have their own problems of rural unemployment. Those who made long stays abroad and brought back capital invested it directly in farms for reasons of personal pride and often paid absurdly uneconomic prices to get land in the old village. There are cases in Lugo where the prices of land exceed those of the *huertas* of Valencia.

It is the influence of these returned emigrants likewise that tends to raise the standards of life in the region, but the necessity of living on the farm produce compels a simple life. A large log fire will be found in every dwelling throughout most of the year. Over it a caldron hangs, in which potatoes and cabbage are constantly stewing. For most people this stew, with a little cured pork or some beans added, and huge, flat loaves of rye bread and cheese form the everyday fare. The dark, acid wine of the region is drunk universally, though to the northeast cider becomes increasingly popular. Soft fruits like apples and stone fruits grow well in most of the region but never reach commercial importance. Along the coast fish is prominent in the diet but never ousts the potato-and-cabbage stew.

The Cultural Landscape

One cultural influence common to most of the peninsula has had no effect on Galicia. The Arabs did not conquer this corner, beaten, no doubt, as much by the unfavorable climate as by the broken mountain country to the southeast. Instead, the Celtic atmosphere remains very prominent today. The nomenclature is distinctly

FIG. 23—Limited spare land in the favored valleys cause *hórreos* to be built at the water edge. View near Padrón.

foreign to Latin speech, and even the Romans did not remain long in these parts. Strabo, writing of this region, remarks on the curious dispersion of Galician people into small villages scattered close to one another, a condition like that of today. Another Celtic touch is given by the popularity of the bagpipes and dances of the reel or jig type. Isolation has preserved local customs to an extent rarely met, and the dialect is strikingly different from the Castilian. Gallegan resembles the Portuguese and has given rise to a regional literary movement similar in style and aspiration to that in Ireland. Much cultural interchange has developed recently between Galicia and northern Portugal. This mutual interest has no inclination toward a political fusion, however, because the standard of living in Galicia is already higher than that in corresponding parts of Portugal, and the best markets for Galician cattle are the large cities of Spain, Madrid and Barcelona—markets that would at once be lost. Among Spaniards Gallegos have a reputation like that of the Irish among the English; "Gallego" jokes take the same turn as English jokes about the Irish and the Scotch. Architecture shows a debased baroque character that is less Roman and more a direct reflection of the granite from which most public places are built. Decoration when used, is heavy, because the granite forbids refinements of detail.

The houses have the simplicity of those of the Scottish crofters. Brickwork is completely absent, and roofs are slated or thatched. Needles of slate are often used as "poles" for vines. The primitive Galician house style is now found only in the difficult and backward districts of the east. These houses are circular, with thick walls of rough-hewn granite or schist, covered by a conical roof of thatch or

FIG. 24—Peasant house near Betanzos in Las Marifias. All features of Galician homesteads are here brought out, giving an intimate picture of the human geography.

slate. They have no windows, no chimney, and no other entrance than the one door. A partition barely half a meter high divides the inside into quarters for humans and for animals. Chairs are rare, and the bedding is home-woven from farm flax or farm wool.

There are now few such primitive dwellings. The average Galician house, which is uniform in character for both grouped and isolated houses, is normally square, with two floors. The lower floor is windowless except for unglazed slits like large letter boxes to give slight illumination to the cattle stalls below. In wine districts a beamed wine press also stands in the gloom of the ground floor. Downstairs is the fireplace, big as a room, where meals are eaten within the chimney, which is usually in the center of the house. Round the fire burning on the floor are settles that have table flaps to them like children's high chairs. The second floor invariably has a balcony of wood at the front within the roof shelter, and access to this floor is outside the house. Walls are very thick, a meter of solid granite being common even for simple farmhouses. The materials reflect the geology: if schist is the country rock, then the house is made from it. A grapevine will trail across the outside walls, even where field vines are not grown. Wooden doors are always divided horizontally, so that the upper part, opened, will give light, while the lower part will keep the pigs from wandering about. Bareness and

simplicity are the indoor style. Most domestic vessels are of wood, few of pottery.

One house in a hamlet stands out as superior to the rest, the manor house, or *pazo*. It is much larger than its neighbors but differs only in size. Some *pazos* include a central courtyard and the trappings of feudal importance, but the only imposing architectural feature will be the door or an elaborate chimney. The gate carries the seignioral arms, carved with a grandeur that makes a paradox of the surrounding squalor and simplicity. Sometimes, even now, the old gate chain can be seen, to touch which assured for fugitive miscreants the protection of the seignior. Most of these *pazos* are abandoned; gradual breakup of the estates, by division among heirs, by neglect of absentee landlords, by the gradual purchase of fragment after fragment by returned emigrants, has left the large houses without economic backing, and it would cost too much to pull them down. "Big farmers" here would be but small farmers in most countries; they make their own plows, carve their own clogs, and do all their own field labor.

Until recent years owners of the *pazos* exacted *foros* or feudal tolls from the surrounding proprietor-tenants. The *foro* resembled somewhat the English tithe but had no church association. Often the *foro* had a service clause in addition to a rent in kind, the service being the typically feudal feature. *Foro* rights were repeatedly sold to intermediaries and slowly increased until they became a heavy burden upon an already close-pressed farming population. Most of the social trouble of the twentieth century in Galicia arose from the *foro* question, but natural purchase of those rights, as emigrants sent back money, and legal compulsion in late years have removed the *foro* from a serious part in Galician affairs today.

Two typical details of the landscape are closely related. First, the commonest nondomestic animals are rodents, the muskrat predominating. It may justly be said that the rat is to Galicia what the lizard and the ant are to Castile. These rats infest every house, every barn, and the banks of every stream and cause protection from them to be an important consideration in the construction of stores. The second detail is a store, outside the house and built upon mushroom legs to keep the rats down. Every farmyard has such an *hórreo* for maize used in the green for cattle feed. The climate being damp, a storehouse had to be devised that would permit a free flow of air about the maize cobs without danger of premature sprouting. The simplest *hórreos* are like loose wicker baskets. The more elaborate ones are structures of solid granite, fretted with vertical slits at the sides and surmounted by a large crucifix, which gives them the appearance of a shrine, to the perpetual wonder of the foreigner passing by. Typically the *hórreos* stand close to the owner's

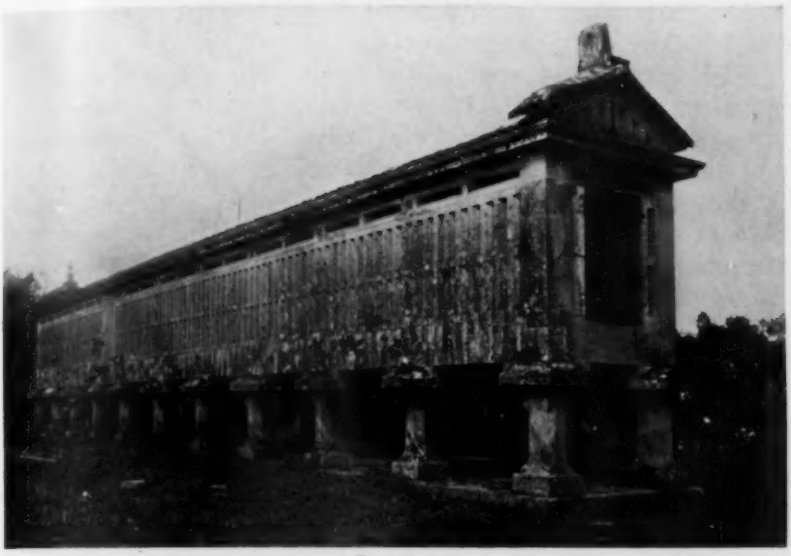

FIG. 25

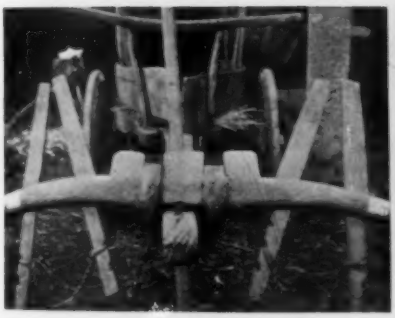

FIG. 26

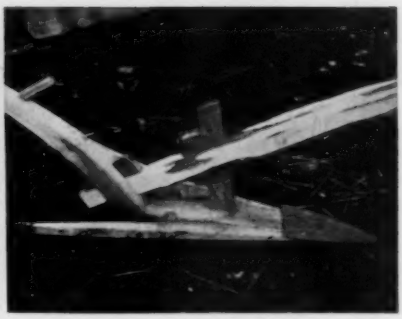

FIG. 27

FIG. 25—Exceptionally large *hórreo* near Pontevedra, built entirely of fretted granite. It stores the maize harvest of one of the few large estates of the region.

FIG. 26—Farm cart and its yoke with a clog being made in background. The T-piece in front of the cart is to prevent the loads of gorse hanging over on to the cows as they bring it from the heath.

FIG. 27—Gallego plough in detail. The entire plough, even down to the forged point, has been made by the farmer himself. In maize country the wings are sometimes two meters long.

house, but often they are grouped dramatically about the *eira* or village green of a house group. This communal patch is the threshing floor, on which, in August, lines of men stand beating rye for one another with dangerous-looking flails called *mallos*.

Strict simplicity in design and materials typifies the agricultural implements in general, but they have shown themselves adaptable enough to meet the special conditions of Galicia. The Galician plow is wooden; many of them have enormous wings to turn over the earth that is tight-matted with humus materials. The solution to agrarian questions in the region does not depend on replacing these plows

with modern metal ones, which, when all is said and done, could not improve the natural poverty of the soil.

The dispersion of population has the important cultural result of making education difficult. Illiteracy shows as a higher percentage in Galicia than in any other region of Spain, since there is the added difficulty of difference between the official language and the domestic Gallegan. An inadequate number of schools aggravates the question so much that Gallegos abroad have maintained at their own expense many educational institutions in their home country. Similarly conditions of family life, combined with the effects of emigration and isolation, makes the region notable for an illegitimacy rate that in many years is more than 15 per cent of the total births.

It is always the more enterprising who emigrate, and when they return they create a social problem by being out of sympathy with regional conditions that differ so sharply from those of the countries where they have lived. It also results that the women are compelled to work at the same labors as men, must maintain themselves and the family patch during the prolonged absences of the men, and must even undertake heavy portering work in the towns.

Less than 8 per cent of the people live in towns. Galician towns retain the countryside interdigitated within them, so that Lugo, closely walled as it is, includes ten hectares of farm land within its walls. Dwellers in the towns maintain intimate working relations with fields and pastures. Coruña ranks as the regional capital, largely on the strength of its position as a port of call and terminus of the arterial railway from Madrid. Vigo is second in importance but first in fishing and canning activities. It has much modern life and handles the Argentine and Brazilian traffic, whereas Coruña handles that of Central America. In most respects Vigo and Coruña are rivals, so that, while Vigo pleads for a new railway to shorten its distance from Madrid by cutting through the difficult Zamora country, Coruña and the present railway vigorously oppose the idea. The new railway has been started for some time but is far from completion. Cultural associations center on Santiago, a town of landed aristocrats, a religious focus, and the only university town in the region, which had great importance in the Middle Ages, when pilgrimages were made to it from all parts of Europe. Monforte, as junction of the Vigo branch of the railway, has much activity in controlling cattle movements from the two zones thus served. For the rest, Galician towns are strictly rural in character. An attempt to create a dockyard and naval center in El Ferrol, opposite Coruña, has had success only because political reasons caused uneconomic circumstances to be ignored. In total, Galicia, by geographical individuality and by human reactions peculiar to it, has a regional unity more sharply defined than most others in Spain.

THE SUBMERGED FOREST OF THE COLUMBIA RIVER GORGE*

Donald B. Lawrence
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FIG. 1—One of the tallest stumps of the submerged forest. Drano Lake, mouth of Little White Salmon River. (Sept. 27, 1934)

The great gorge of the Columbia River, which forms part of the boundary between Oregon and Washington, has been cut to a depth of more than 4000 feet directly across the axis of the Cascade Range. Throughout the gorge the river, flowing almost at sea level, is bordered by moist bottom lands, occupied by large cottonwoods, several species of willow, and ash trees. These lands are inundated for several weeks at every spring freshet. Neither the Douglas firs and giant cedars nor the Garry oaks and ponderosa pines that clothe the gorge walls are now found growing on these annually flooded marginal lands, but numerous partly decayed stumps of these species stand upright in the river bed above the Cascade Rapids, where they were observed at least a hundred and thirty years ago, when that part of the gorge first became known to the white man. They constitute the well known "submerged forest" of the Columbia Gorge.

Some stumps are found among living cottonwoods and willows on the bottom lands (Fig. 3), others stand far out in the stream, as much as 50 yards from the shore even at times of lowest water (Fig. 2). The total number of stumps must be large; about 1800 were visible during the low water of 1934. Singly and in groups they are scattered along both shores for a distance of 25 miles above the Cascade Rapids (Fig. 4).

*The writer's interest in the submerged forest was first aroused by Mr. J. Neilson Barry, the author of "The First Explorers of the Columbia and Snake Rivers" in the July, 1932, number of the *Geographical Review* (Vol. 22, pp. 443–456), whose researches on the submerged forest are described in "The Drowned Forest of the Columbia Gorge," *Washington Hist. Quart.*, Vol. 26, 1935, pp. 119–122. Valuable help is acknowledged from Mr. Barry and from Mr. K. N. Phillips, associate engineer of the U. S. Geological Survey, Portland. Miss Isabel Nichol, assistant at the central public library of Portland, Oregon, aided in the assembling of historical data, and Elizabeth G. Lawrence, the writer's wife, helped in this and other ways. Professor Burton E. Livingston of the Johns Hopkins University kindly criticized this article during its preparation. It is *Botanical Contribution No. 140* of the Johns Hopkins University.

Near the foot of the rapids is the site of the Bonneville Dam, now under construction as a part of the Columbia River Development. This project has awakened interest in the collection and preservation of archeological relics in the area to be flooded. The studies reported in this paper and the photographic records shown[1] in it were made with this in mind.

FIG. 2—The western group of stumps at Wyeth as it appeared when the river was at a very low stage. Looking eastward. (Oct. 14, 1934)

DESCRIPTIONS AND EXPLANATIONS

The local Indians had legends to explain the drowned trees, and most writers dealing with this part of the Columbia River have had something to say about the problem. The Indian legends seem to have been in essential agreement. They tell that "long time back" there extended across the gorge from rim to rim, near the site of the Cascade locks, an enormous natural bridge, the Bridge of the Gods; that the Indians of two or three generations back were able to ascend the river in canoes, passing under the bridge and on, without portage, even as far as The Dalles; that in a tumultuous battle between the snow-capped peaks of Mt. Hood and Mt. St. Helens the great bridge fell into the river and blocked it, so that when the resulting lake began to drain, the present rapids came into existence.

[1] The writer has been able to find only two published photographs of the submerged-forest stumps: both were taken at the Wyeth group. One of the photographs was published twice (J. H. Williams: The Guardians of the Columbia, Tacoma, 1912, p. 39; J. S. Diller and others: Guidebook of the Western United States, Part D: The Shasta Route and Coast Line, *U. S. Geol. Survey Bull. 614*, 1915, Pl. 10A), and the other appeared in a local newspaper (J. L. Brogan: Mountain Which Moved Now Stable, *Sunday Oregonian*, May 29, 1927).

The appearance of the gorge walls at this place, especially the north wall, might easily lead to this naïve supposition about a fallen bridge of rock, but there is no geological evidence in its favor.

Lewis and Clark were apparently the first to record observations concerning the drowned stumps, when they passed down through the Columbia Gorge in October, 1805, with the other members of their

FIG. 3—Stumps protruding from the bottom lands near Herman Creek Ranger Station, almost half a mile from the river channel. The small stream in the foreground has eroded away the silt from about the stumps. Looking northward. (Sept. 17, 1934)

expedition. Captain Lewis summarized his ideas concerning them in his diary under date of April 14, 1806, while the expedition was returning eastward up the river.[2]

> Throughout the whole course of this river from the rapids as high as the Chilluckkittequaws [an Indian community at the mouth of the Klickitat River], we find the trunks of many large pine trees standing erect as they grew at present in 30 feet of water; they are much doated and none of them vegetating; at the lowest tide of the river many of these trees are in ten feet of water. Certain it is that those large pine trees never grew in that position, nor can I account for this phenomenon except it be that the passage of the river through the narrow pass at the rapids has been obstructed by the rocks which have fallen from the hills into that channel within the last 20 years; the appearance of the hills at that place justify this opinion, they appear constantly to be falling in, and the apparent state of the decayed trees would seem to fix the era of their decline about the time mentioned.

The Reverend Samuel Parker, who passed down the river through the gorge in October, 1835, gives a vivid and apparently accurate description, telling how he "had to pick" his way down the river

[2] R. G. Thwaites, edit.: Original Journals of the Lewis and Clark Expedition, 1804–1806 (7 vols. and atlas), New York, 1904–1905, Vol. 4, pp. 279–280.

"with the canoe, in some parts as through a forest," and how, although he looked especially for evidence of the stumps "having slidden down from the adjacent hills by escarpment," he found many of them even where there were no hills close to the river. He consequently expected to find a dam still farther downstream, but when he came to the rapids, he found neither a dam nor any indication that a dam had previously existed.

> On a full examination, it is plainly evident that here has been a subsidence of a tract of land, more than twenty miles in length, and about a mile in width. The trees standing in the water are found mostly towards and near the north shore, and yet, from the depth of the river and its sluggish movement, I should conclude the subsidence affected the whole bed. That the trees are not wholly decayed down to low water mark, proves that the subsidence is comparatively, of recent date.[3]

Lee and Frost in 1844 stanchly opposed Parker's conclusion, saying that

> the supposition that a subsidence has occurred here appears groundless. Admit a dam at the Cascades, and these appearances perplex no more, their origin seems natural. At the Cascades there are indications that the stream has left its former bed, in which its course was westward, and abruptly turning to the south, rushes on and plunges down in that direction nearly a mile.[4]

Lee and Frost's observations, presumably made about 1838, led them to think that a great landslide had occurred there and that the course of the river had been definitely shifted by it.

Joseph Drayton of the Charles Wilkes Expedition[5] made some observations on the submerged forest in 1841. He thought

> that the point on which the pine forest stands, has been undermined by the great currents during the freshets; and that it has sunk bodily down until the trees were entirely submerged.

Explanations similar to this are advanced even today by fishermen and boatmen who gain their livelihood on this part of the river and who use the stumps as mooring posts for their log rafts, tugboats, and fish-wheel barges.

Captain J. C. Frémont, who passed up the river in 1843, had heard of the Cascades "dam" hypothesis. He says:[6]

> I venture to presume that the cascades are older than the trees: and as these submerged forests occur at five or six places along the river, I had an opportunity to satisfy myself that they have been formed by immense land-slides from the mountains, . . which brought down with them the pines of the mountain.

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[3] Samuel Parker: A Journey beyond the Rocky Mountains . . . . 3rd edit., Ithaca, N. Y., 1842, p. 141.

[4] D. Lee and J. H. Frost: Ten Years in Oregon, New York, 1844, p. 200.

[5] Charles Wilkes: Narrative of the United States Exploring Expedition . . . (5 vols. and atlas), Philadelphia, 1845. Vol. 4, p. 381.

[6] J. C. Frémont: Narrative of the Exploring Expedition to the Rocky Mountains . . . London 1846, p. 203.

In 1887 C. E. Dutton advanced the theory[7] that

> there has been an uplift of the entire platform athwart the river-valley [at the Cascade Rapids] in the shape of a very flat anticlinal arch. The width or span of this arch is about five and a half miles, and the eastern branch of the flexure is steeper than the western. The displacement is not recent in a historical sense, but it is probably post-glacial.

Except Dutton, all writers up to that time seem to have thought that the impounding of the river must have taken place within a century or two.

According to S. A. Clarke, W. Hampton Smith satisfied himself that no natural bridge had been possible at the Cascades and that the formation of the rapids must have occurred between 1100 and 2000 years ago.[8] Smith seems to have based these conclusions on his discovery of glacial ridges parallel to the river in the region where the bridge is supposed to have been. Later geological investigators, on the basis of other evidence, have agreed with Smith that no rim-to-rim bridge could have existed within at least many thousand years. In the "Guidebook of the Western United States"[9] three possible causes of the dam are suggested: an uplift, a fault, or a landslide. The authors conclude that "not enough geologic work has been done in the vicinity to determine which explanation is the true one."

Ira A. Williams in 1916[10] described so clearly the evidences of great landslide activity in the region between Greenleaf Peak and Cascade Locks—the unstable, broken terrain, the many small lakes without visible outlets, and the absence of any drainage system on the slide material—that all doubt concerning the real origin of the Cascade Rapids has been dispelled. He confirmed Lee and Frost's conclusion that the river's present course through the rapids is different from its course before the landslide. Other writers are in agreement.[11] The origin of the submerged forest may thus be outlined.

Probable Course of Events

At some former time the Columbia River, flowing smoothly seaward, pressed close to the base of the north wall of the gorge, against former cliffs of Table Mountain and Greenleaf Peak (Fig. 4). These

[7] C. E. Dutton: The Submerged Trees of the Columbia River, *Science*, Vol. 9, 1887, pp. 82–84, reference on p. 83.

[8] S. A. Clarke: Pioneer Days of Oregon History (2 vols.), Portland, 1905, Vol. 1, pp. 140–141.

[9] Diller and others, *op. cit.*, p. 27.

[10] The Columbia River Gorge: Its Geologic History Interpreted from the Columbia River Highway, *Mineral Resources of Oregon*, Vol. 2, No. 3, 1916.

[11] L. F. Harza: Report of Possibility of Power Development at the Cascades of the Columbia River, in Oregon's Opportunity in National Preparedness, by J. H. Lewis and others, *Oregon Office of State Engineer Bull. No. 5*, 1916, pp. 36–50; E. T. Hodge: Bonneville Power and Navigation Project: Ruckel Stability Report, submitted May 31, 1934, unpublished, on file in Portland, at the office of the District Engineer, U. S. War Department, second Portland district; C. P. Berkey: Foundation Conditions for Grand Coulee and Bonneville Projects, *Civil Engineering*, Vol. 5, 1935, pp. 67–71.

3400-foot heights are capped by a hard layer of basalt 1500 feet thick, which rests on the easily eroded Eagle Creek formation, whose bedding planes slope toward the river. While this basaltic cap was being undermined by the river, the land was also subsiding. Upstream for a score of miles the channel lay about as it does now, but it was deeper and in many places narrower at high water by at least 70 yards than it is today at low water. Upland trees grew down to the edge

FIG. 4—Map showing the distribution of the submerged forest stumps, the Cascade landslide and its place of origin, the old river channel that was blocked by the slide, and the site of the Bonneville Dam (compare Fig. 5).

of this ravine, where their roots were seldom or never flooded by spring freshets. When the river bed had subsided to about 100 feet below present mean sea level, according to Hodge, the undercut north wall toppled over into the channel at a point (Fig. 4) about two miles due west of the present town of Cascade Locks and precipitated a landslide that carried millions of tons of rock and soil into the channel and across to the south wall of the gorge. The slide may have been cataclysmic, as most students seem to have thought, or it may have been more or less gradual, as Berkey[12] implies, but there is no reason to doubt that an effective dam was created impounding the river above.

On a smaller scale the landslide that dammed the Gros Ventre River, in northwestern Wyoming, in 1925[13] may have resembled the ancient Cascade slide. According to eyewitnesses, a great mass of displaced material rushed down the mountain, across the river valley, and even some distance up the farther side.[14] Many coniferous trees rode down on top of the slide, some remaining nearly erect. Two years later the resulting dam broke, and the impounded water escaped to the valley below.[15] In June, 1935, the writer visited the area and

[12] *Op. cit.*

[13] Landslide Dams the Gros Ventre River in Wide Canyon, *Engineering News-Record*, Vol. 95, 1925, p. 116.

[14] F. B. Emerson: 180-Foot Dam Formed by Landslide in Gros Ventre Canyon, *Engineering News-Record*, Vol. 95, 1925, p. 467.

[15] W. C. Alden: Landslide and Flood at Gros Ventre, Wyoming, *Trans. Amer. Inst. of Mining and Metallurgical Engineers*, Vol. 76, 1928, pp. 347–361.

counted the growth rings of several of the largest living Douglas firs and other coniferous trees on the slide. None of them were more than 40 years old when the slide occurred. The numerous older trees apparently had not been able to recover from this violent transplant-

FIG. 5—Aerial view eastward across the Cascade landslide (arrow shows direction of slide). The approximate course of the river before the slide is shown by dashed lines (compare Fig. 4). Bonneville Dam site in the foreground. (Brubaker Aerial Photograph No. 33096)

ing and to adapt themselves to the new conditions and were all dead.

To judge from the present topography, the crest of the great dam that resulted from the Cascade landslide must have been at least 200 feet above present sea level. If the dam held water until it overflowed at the 200-foot elevation, the lake above the dam must have been at least 90 miles long, its area more than 88 square miles, and its volume more than 5,200,000 acre-feet. We cannot be certain about its maximal extent, for it left no visible shore lines; but we may be sure that for 25 miles above the dam the water rose on the floor and walls of the gorge and drowned thousands of trees in that region and that it extended beyond the east portal of the gorge far into the treeless region of the Columbia basin. With overflow, cutting of a channel in the slide material began. Thus the present great bend of the Cascade Rapids, as much as a mile and a half southeast of the previous course, was formed. The lake persisted long enough to permit sediment to accumulate to a depth of at least 25 feet around the trunks of many of the drowned trees. As the dam was eroded and the lake drained, portions of the lake floor became exposed, and

the drowned trees were left standing in the mud. Then their exposed parts rotted down to the surface of the silt, a process that takes about 75 years for a dead but erect Douglas fir under usual forest conditions in western Oregon. That at least this amount of time must have passed before Parker's visit of 1835 seems evident from his statement

FIG. 6—A submerged forest stump with its root system exposed (center) and a very tall stump still partly submerged (right). View southward at the mouth of Wind River; Shellrock Mountain in the background. (Aug. 21, 1934)

that "above the freshet rise, the tops of the trees are decayed and gone." Subsequently the river eroded the silt in places and partially exhumed the unrotted stumps, and each year, as this erosion of the lake bed continues, stumps that have remained wholly or partly buried and thus protected are gradually brought into sight. The tallest stumps are found near the west end of the ancient lake, where deposition by tributary streams was greatest. A few stumps as much as 25 feet tall standing in the river channel half a mile above the present mouth of Wind River show that a deep delta was formed by that river during the lake era (Fig. 6). Near the eastern limits of the gorge, where less tributary deposition occurred, the stumps are so short as to be visible only at very low water. Beyond the east portal no stumps are found, probably because the climate, as at present, was unfavorable for tree growth in that region; but even if trees were drowned along that part of the river, it is highly unlikely that they would be preserved until today because of the small amount of protective silt deposited there during the lake era.

In places where the lake deposit is composed of fine silt with a large content of organic matter the buried parts of the stumps are

beautifully preserved, even the bark remaining in place (Fig. 8); but where the stumps are surrounded by coarse gravel, both bark and sapwood are gone. None of them bear branches. The wood of many of the stumps is sound and hard, and when cut gives off the characteristic odors by which wood from living trees of the same

FIG. 7—One of the easternmost groups of the submerged forest stumps. View westward toward Stanley Rock and the Hood River-White Salmon toll bridge. Note how short the stumps appear even at very low water. (Sept. 23, 1934)

species may be recognized. There is no evidence of petrifaction.

As the protective lake deposit about the stumps is eroded by the river, decay begins again. It is still in progress; but the rate of decay must be slow indeed, for the stumps have apparently changed but little since they were described by Parker 100 years ago. The slowness of the decay of the stumps may have been due, in one way or another, to their having been water-soaked for so large a part of each frostless season. By mid-May the river has usually risen considerably, and in late June and early July all the stumps are usually completely submerged. As the water level falls after the spring freshets, the stumps dry very slowly. As long as their bases are submerged, capillary rise of water through the wood probably keeps it nearly saturated even to the top, except for a thin peripheral layer above the level of submergence. We may suppose that conditions are unfavorable for the processes of decay except for a short period at the beginning and end of each frostless season. It may be added that fruiting bodies of fungi have not been observed on the stumps, even near their tops.

Tree-Ring Dating by Correlation

In connection with a special investigation by the writer of the wind-blown fir trees of the gorge it appeared that the Douglass method for correlating past climates by means of measurements and counts of tree rings[16] might perhaps be applicable in the study of the submerged forest. Such a method was recently essayed by Lyon and Goldthwait in their study of submerged forests on the North American Atlantic seaboard.[17] The ring patterns of upland trees now growing in the vicinity of the submerged forest of the Columbia River Gorge show remarkable agreement. If any of the oldest firs now growing on the near-by gorge walls were youthful contemporaries of the drowned trees when these died, then one might reasonably look for an overlapping between the ring patterns of the living and the dead and a clue to the approximate date of landslide and submergence.

Fig. 8—Partly excavated Douglas fir stump of the Wyeth group, showing well preserved bark below the level of the silt surface. Looking northwestward. (Aug. 27, 1934)

A series of preliminary borings of submerged-forest stumps, made soon after the spring freshets of 1934 had receded, gave encouraging results, and a special study of the stump ring patterns was undertaken in the summer of that year.[18] About each of five selected stumps in one of the main groups of submerged stumps near Wyeth, Oregon, a pit was dug, large enough for an 8-foot saw to be operated horizontally at a depth of 3 to 6 feet. The stump was then sawed off several

[16] A. E. Douglass: Climatic Cycles and Tree-Growth. *Carnegie Instn. Publ. No. 289* [Vol. ii, 1919; *idem*: The Secret of the Southwest Solved by Talkative Tree Rings, *Natl. Geogr. Mag.*, Vol. 56, 1929, pp. 736–770.

[17] C. J. Lyon and J. W. Goldthwait: An Attempt to Cross-Date Trees in Drowned Forests. *Geogr. Rev.*, Vol. 24, 1934, pp. 605–614.

[18] Through the coöperation of Mr. Thornton T. Munger and Mr. Leo A. Isaac of the Pacific Northwest Forest Experiment Station arrangements were made by which considerable assistance was provided by the U. S. Civilian Conservation Corps. Means for transporting the men to and from work and many other facilities were provided by the writer's parents, Mr. and Mrs. W. C. Lawrence, of Portland, Oregon.

feet below the level of the silt surface, and a cross section 3 to 6 inches thick was cut near the basal end of the resulting log. The sections had the bark still in place. Four firs and one cedar, all standing within a space not more than 200 yards across, were thus sectioned. A section was also taken, in like manner, from a well preserved fir stump of another group, near the mouth of Perham Creek, about six miles upstream from the Wyeth group. There are at least 330 stumps in the Wyeth group and about 40 in the Perham Creek group.

Three of the fir stumps of the first group, with 129, 115, and 260 growth rings, and the one from Perham Creek, with 212 rings, agreed in showing certain peculiar narrow rings similarly placed on all radii. But the fourth fir stump of the Wyeth group, a veteran of about 325 years, failed to show any notable ring-pattern resemblance, and the rings of the single cedar stump sectioned were uniformly broad and lacking in pattern.

It was shown that submerged trees at least six miles apart died the same year: this may be taken as evidence in support of the supposition that the trees of the submerged forest probably died as the result of a single flood. Furthermore, the fact that all the submerged stumps are erect would make it unlikely that different parts of the gorge walls slid down at various times into a previously impounded river.

In an attempt to cross-date the submerged fir stumps with very old trees of the same species growing near by, three of the largest firs on the slopes of the gorge walls were felled,[19] and a cross section was taken from the butt of each log. The sections showed the same ring pattern, though they came from trees growing from one to four miles apart and at elevations differing by several hundred feet. But no notable correspondence could be detected between the central portion of the characteristic ring pattern of the three living trees and the peripheral portion of the characteristic pattern of the four ancient fir stumps. It should be remarked that in Douglas firs of this part of the gorge the rings of the first two or three decades of growth do not generally lend themselves satisfactorily to studies of this sort. Nevertheless, as the oldest living tree studied was about 260 years old, it is surely safe to say, on the basis of this comparison, that the ancient trees must have been killed more than 200 years ago, or at least 70 years before their stumps were seen by Lewis and Clark.

Levels of Stump Roots and Presumable Flood Levels before the Ancient Landslide

In mid-October of 1934, when the river was at a very low stage, the depth below the water surface of several submerged-stump root

[19] Permission to cut these trees was granted by Mr. Cassius F. Sundy, Mr. Charles Sigl, and Mr. Walter H. Suhl, owners of the lands upon which they grew.

systems was measured from a small boat. A sample of wood was taken from the tip of each stump for subsequent species identification.[20] Each depth record obtained was computed to mean sea level by reference to the official gauge reading for the same day in the upper pool of the Cascade locks, where daily records of water level have been kept for 55 years.

The most deeply submerged root system measured was that of a stump of Garry oak standing at that time about 50 yards from shore and in 10 feet of water, near Wyeth. Its upper roots were computed to be 33.5 feet above mean sea level. Near by was found a Douglas fir stump whose upper roots were only one foot higher. At elevations only two or three feet higher stood the stumps of many firs and cedars.

To approximate the average flood level of the river just before the ancient landslide, it was supposed that at that time there was no obstruction in the river at the place where the rapids are today and that the river gradient upstream from what is now the foot of the rapids was gentle and uniform throughout the whole stretch of the "submerged" forest, which was then, of course, a living forest along the banks. On the basis of that supposition, and with the aid of the flood records for the upper pool of the Cascade locks, it was possible to estimate the probable average flood level at that ancient time in the neighborhood of the fir stump with deepest root system just mentioned. It appears from the resulting approximation, which is naturally not very definite, that the uppermost roots of that fir were several feet above the level reached by most of the ancient floods in the time of its life.

In a recent study of the elevations of the root systems of living trees of fir, pine, and oak growing closest to the river in the vicinity of the submerged forest the writer has found that Douglas fir seems to be much less tolerant of flooding than are the other trees that grow with it on the uplands of the gorge. It is safe to suppose that the roots of the particular tree here considered were not submerged many times or for prolonged periods by the usual spring freshets of its lifetime. It almost certainly escaped drowning until it and all its neighbors were killed by the rising water of the impounded river after it had been dammed by the ancient landslide.

In the light of this very brief study of probable ancient flood levels and levels of stump root systems, it seems unnecessary to hypothesize subsidence of the land, rise of sea level, or increase in river volume to account for the submerged forest. Unless more deeply submerged stumps of Douglas fir are found, we may be fairly confident that no marked geographical change has occurred since the damming of the river and the death of the submerged trees.

[20] Identification by Mr. J. E. Lodewick of the Pacific Northwest Forest Experiment Station.

AN EMPIRICAL CLASSIFICATION OF FLOOD-PLAIN STREAMS

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FLOOD-PLAIN streams may be classified according to the geological work they have accomplished on the flood plain. The relationship between a stream's work and the observable flood-plain features is, in a general way, quite clear as long as one remains in the realm of geomorphology and avoids hydrodynamics. Few surficial features are more complex than these elongate masses of alluvium, yet there are few whose immediate origin is more apparent. Sufficiently detailed information being available, a classification of flood-plain structure is thus a system for classifying stream activity.

Such a system is, in effect, a grouping of flood-plain streams according to the work accomplished in times of high water. It is then that streams possess the most energy; it is then that the geological environment undergoes its greatest changes. During low water most streams do little more than modify in a trivial way the features formed during the last flood. To classify a stream according to its activity during times of slight volume is, therefore, to emphasize that which is relatively unimportant.

A useful classification should facilitate the ready description of both the common and the unusual flood-plain conditions and, thus, of common and unusual stream work. An orderly, recurrent event, such as channel deepening, and an accidental one, such as a change of climate, have their effect, not merely in the channel, but also in the formation of the surrounding plain.

In presenting a system based on attributes of the flood plain the writer does not deny the need for a study of flood-plain history in general. Although such studies underlie the commonly used system, its principal concepts—youth, maturity, and old age—are perhaps, in their connotations, unduly remote from the facts of observation. For example, those sections of a stream that are "old" have not necessarily been "mature," and "mature" sections are by no means always found down-valley from those in "youth." Accordingly, in this paper streams are classified locally, on the basis of their flood-plain structure; and, except for a few minor instances, no attempt is made to show the sequence of form that a given flood plain will follow in the course of its history. The system is, in short, an empirical classification of flood-plain streams in general, though it points out clearly that, at a given place, the genetic connection between a stream and its flood plain is very close. Whereas the use of a genetic classification would involve the assumption that the object of study reached its present

condition because of, or after, a transition through known preliminary forms, the proposed system, on the other hand, involves no assumption save possibly that the distinctive geological work that a stream has accomplished in its late past will continue to be the result of its activity for a short while in the future. This system is thus a logical arrangement of temporary features; its value will be determined by the degree to which it aids in the development of a more complete genetic model than has thus far been invented.

Single-Crest Streams

The classification is based on three groups of streams, each of which has accomplished only one phase of geological work. They are called *single-crest* streams and are recognized by the manner in which their flood plains have been constructed.

In the first group (I) are placed flood plains seldom or never subject to over-bank floods and thus lacking sedimentary deposits on the surface, yet possessing low-water channels that move from side to side in the development of meandering curves. Such plains without an alluvial cover[1] have been called flood plains of "lateral corrasion."[2] The most obvious modification of the geological environment is the formation of meander loops. Although many examples could be given, one suffices—the Connecticut River near Haverhill, New Hampshire, a rapidly meandering river without noteworthy deposit of vertical accretion. A surface built by the meandering process may be called a *meander plain*.

In the second group (II) are placed flood plains which are surfaced with an alluvial layer and through which the low-water channel does not actively meander. Such plains usually possess natural levees, and the deposited cover, derived from the suspended load, is frequently found to be quite thick. The flood plain of such a stream, which is exemplified by the Mississippi River near New Orleans and by several of its tributaries, may be called a *covered plain*.

Streams with neither a low-water channel nor an alluvial cover are placed in the third group (III). This type of stream has a relatively smooth flood plain, the topographical detail of which is a network of "bars," elongate in shape and irregular in size, built from the tractional and suspended load in the declining stages of the last flood. During low water the flood plain is only slightly modified. The appearance at this time of any tendency toward the formation of a definite low-water channel, whether curved or straight, is thoroughly corrected during the next flood. These are the typical "braided streams" of

[1] N. M. Fenneman: Floodplains Produced without Floods. *Bull. Amer. Geogr. Soc.*, Vol. 38, 1906, pp. 89–91. On page 90 the author describes flood plains of *lateral accretion* and *vertical accretion*, which are the same as the meander plain and the covered plain of this paper.

[2] G. K. Gilbert: Report on the Geology of the Henry Mountains, 2nd edit., U. S. Geographical and Geological Survey of the Rocky Mountain Region, Washington, 1880, p. 126.

FIG. 1

FIG. 2

FIG. 1—The meander plain of the Connecticut River near Haverhill, N. H. The long, closely fitting ridges within the large meander loop have been built, during bank-full stages, at the inner edge of the low-water channel. They are called "scrolls." The outer bank has experienced erosion at such a rate that the channel has maintained uniform width. (Fairchild Aerial Surveys, New York.)

FIG. 2—The covered plain of Bayou Black, just east of Morgan City, in Terrebonne Parish, La. Natural levees have developed to considerable size. (Fairchild Aerial Surveys, Los Angeles.)

geological literature. Examples are numerous, especially among the valley trains. In the United States a well known stream is the Canadian River of western Oklahoma.[3]

It is believed that the term "braided" as applied to stream channels is a superficial one, since it is usually just the low-water stream that is subdivided in this unique fashion. In extreme floods the entire plain is covered with water actively engaged in modifying the surface. Furthermore, the degree of "braiding" is dependent on the volume of water that remains during low stages rather than on the nature of the flood-plain surface. Many streams not classified as braided have this appearance during times of intense drought.

The plains of the third group will be called *bar plains*. They are thus removed from the class of exceptional or anomalous features, to which they usually have been assigned, and are made part of a systematic classification.

In summary, three extreme types of single-crest streams are recognized. In each the stream during flood modifies its geological environment in only one way: (I) A meander plain is built. (II) An alluvial covered plain is deposited, chiefly from the suspended load. (III) A bar plain is built from the tractional as well as from the suspended load.

Scroll, Bar, and Lacine Meander Plains

Meanders are of three types, the direct geological causes of which appear to be somewhat different. One extreme type, here called the *scroll meander*, consists of long, curving, parallel ridges (scrolls)[4] that during stages of high water have been aggraded against the inner bank of the meandering channel, while the opposite bank experienced erosion. Many flood plains are composed of an interlocking nest of such scrolls, which, when typically developed, are narrow, uniform in height, closely spaced, and smoothly curved. The outer, eroding bank is usually cut at such a rate that the low-water channel maintains nearly uniform width as it shifts through the flood plain. The simplest explanation for this symmetrical relationship of smooth curve and uniform width is one that has long been used—that the scroll building on one bank is the immediate cause of lateral corrasion on the other.[5] Such scroll meanders may also be called "meanders of forced cut" or "forced meanders" when emphasis is to be placed on the process.

[3] The Platte River of Nebraska cannot definitely be classified with this group because of inadequate published data. It may belong with the double-crest streams to be discussed below.

[4] This meaning of the term "scroll" is more restricted than that applied by Davis (W. M. Davis: Meandering Valleys and Underfit Rivers, *Annals Assn. of Amer. Geogrs.*, Vol. 3, 1913, pp. 3–28; reference on p. 9), who included under it all of the alluvial land built by a stream on the inner bank of a shifting channel.

[5] J. W. Powell: Physiographic Features, *in* The Physiography of the United States, National Geographic Society, 1896, pp. 33–64, reference on p. 38; G. H. Matthes: Floods and Their Economic Importance, *Trans. Amer. Geophys. Union, Fifteenth Ann. Meeting, April 26, 27, 28, and June 20, 21, 1934*, Washington, 1934, Part 2, pp. 427–432, reference on p. 429.

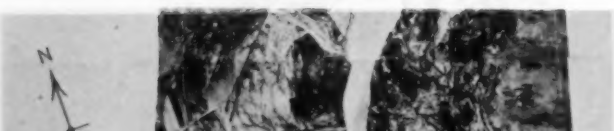


FIG. 3

FIG. 4

FIG. 3—The bar plain of an unnamed river flowing into the north fork of the east arm of Berner's Bay, Alaska. The water is at a low level. Alaskan flood plains such as this are said to be usually completely submerged once a year. (Courtesy Alaskan Branch U. S. Geological Survey.)

FIG. 4—The scroll meander plain of the Pembina River, Manitoba. Activity consists of scroll building on the inner bank and lateral corrasion on the outer bank of curves, the two proceeding at a balanced rate. If scroll building is the cause of the corrasion, these features may be called "meanders of forced cut." Considerable regularity in the occurrence and height of floods is indicated. (Courtesy Royal Canadian Air Force and Dr. D. A. Nichols.)

Examples are found in the Connecticut River near Haverhill, in the Pembina River of Manitoba, and in many streams of humid regions.

The other extreme type of meander has received slight attention. Certain rivers, especially in arid regions, display low-water channels of very unequal width. Flood-plain cutting on one side is not balanced by equally rapid flood-plain building on the other. Sharp angles and abrupt turns are common. The outer bank of meandering curves appears to collapse before the shifting current, and unassimilated masses of sand are left to clog the channel. Deposition near the inner bank takes place irregularly; instead of symmetrical scrolls, a series of nondescript, elongate channel bars are built, among which, during the dry seasons, small branches of the stream thread their way. These bars are practically identical with those of the bar plain discussed above; they are features of the channel bottom and not of the channel bank.

In all observed cases in which the low-water channel is extremely wide at the meander loops it has the appearance of a true bar plain ("braided stream"), though in the succeeding "narrows" it loses

FIG. 5—The bar meander plain of the Colorado River near Blythe and Palo Verde, Cal. Lateral corrasion in the outer bank of meander loops proceeds in advance of deposition near the inner bank, thus suggesting the name "meanders of advance cut" or "induced meanders." Length of the mosaic is more than 22 miles. (Courtesy of the Bureau of Reclamation, Department of the Interior, and the Fairchild Aerial Surveys, Los Angeles.)

these characteristics. The Colorado River south of Boulder Dam has several flood-plain sections in which the low-water channel meanders rapidly, the minimum width of the channel being less than one-tenth of the maximum, which is commonly at the place of greatest curvature. If one were to consider the channel solely at the meander loops, the flood plain would be classified as a bar plain with a higher meander plain, a combination that would signify a pronounced change in regimen, perhaps because of climate or other accidental cause. However, in spite of the bar-plain characteristics of the channel at the points of greatest curvature, the flood plain of the Colorado shows the results of extensive meandering and thus forces its classification as a meander plain. This illustrates again the need for concentrating attention on the work accomplished during high water rather than on the appearance of the channel bed during low water.

Fully aware that the dynamics of meandering have been under discussion by hydraulic engineers for a long time, the writer ventures to suggest that, in this case, so far as geological causation is concerned, the outer bank of the channel is eroded so rapidly that deposition against the inner bank fails to keep pace. Such meanders, which resemble the bar plain at the points of greatest curvature, may be called *channel bar meanders* or merely *bar meanders*. They may also be spoken of as "meanders of advance cut" or "induced meanders" when emphasis on the cause is desired.

Intermediate between these two extreme types there exists a meander that is due to a combination of forced cut and advance cut. Although aggradation against the inner bank appears to have forced the compensating outer corrasion, the corrasion is somewhat retarded and is, in part, spasmodic and unpredictable. The low-water channel is thus left with a sufficiently unequal width, regardless of the stage, to set it off distinctly from that of a scroll meander. The aggraded ridges, built against the inner bank during ordinary floods, are not as long, as smoothly curved, or as closely spaced as the more symmetrical scrolls. These detached ridges frequently are found to spread apart like the rays of a fan, so that "sloughs" of considerable size are left between. Each ridge is like a detached tongue-shaped scroll and may fittingly be called a lacine.[6]

The Mississippi from Cairo to Baton Rouge is an example of this "rough adjustment" between "cut" and "fill." The river is usually narrowest at the places of sharpest curvature, an indication that filling on the inner bank may proceed in advance of corrasion on the outer. In the straight reaches, however, the greater width of the channel suggests that widening is a process that takes place by reason of causes other than direct corrasion and that, therefore, frequently proceeds independently of it. Perhaps in this part of the Mississippi

[6] From the Latin *lacinia*, "flap" or "tongue."

slumping of the channel walls because of wetting is relatively more important than in streams with scroll meanders but less effective than in those with bar meanders.

Meanders of this intermediate type may be spoken of as *detached scroll meanders* or *lacine meanders*. In addition to the Mississippi

FIG. 6—The lacine meander plain of the San Joaquin River near Modesto, Cal. The lack of a close adjustment between ridge building and lateral corrasion, while not so great as in the Colorado, is sufficient to maintain a low-water channel of unequal width. (Fairchild Aerial Surveys, Los Angeles.)

above Baton Rouge, other streams which are known to meander in this way are the lower Rio Grande and the San Joaquin near Modesto, California. Many flood-plain streams of arid and semiarid regions possess meanders of this type, as do many underfit streams of glaciated country. An incised stream may fall in this category during the process of sweeping its valley walls, as may a stream that has been controlled and partially diverted by artificial means. There is more variation among lacine meanders than among the other two classes; when new types are described, they will no doubt subdivide or replace this class.

Flood plains that resemble the Connecticut may be called *scroll meander plains*, or "meander plains of forced cut"; those resembling the Colorado, *bar meander plains*, or "meander plains of advance cut"; those resembling the San Joaquin, *lacine meander plains*, or "meander plains of both forced and advance cut."[7]

[7] Although the Mississippi exemplifies the development of lacine meanders, its flood plain cannot be listed as a lacine meander plain, since it has a higher plain of vertical accretion and thus comes in the class of double-crest streams to be presented below. Available information is inadequate completely to classify the lower Rio Grande.

Regarding Causation of Single-Crest Streams

It may be profitable to speculate on the possible causes of the separate existence of different types of flood-plain activity. The rare occurrence of the accidental superflood, carrying a large suspended load, is no doubt an important contributing cause to the existence of meander plains which are free from a surface cover. The nature and density of the vegetation, the presence or absence of abundant colloids, and other factors affect the resistance of flood-plain materials—a property that is of paramount importance. Where the alluvium is weak and subject to ready scour, the flood plain may be rapidly reworked by the meandering process, thus destroying surficial deposits before they grow to noticeable thickness. It seems possible that the lack of valley walls sufficiently close together to confine the water and raise the level of extreme floods well above the surface of the plain may likewise be a cause of the absence of surface deposits. For example, the Colorado flood plain, which lacks an alluvial cover, is, in places south of Boulder Dam, more than fifty times as wide as the narrowest parts of the low-water channel. On the other hand, the flood plain of the Connecticut near Haverhill is only ten times the width of the channel and is confined between steep walls, yet it does not possess a surface of vertical accretion.

The bar plain is constructed by streams that during floods move large quantities of sediment, both as tractional and as suspended load, the mutual relationship of contributed load and gradient apparently being the controlling condition. The activity, when the water is high, is quite unlike that of a stream in extraordinary flood on a covered plain. The bar-plain stream, during floods, is a vigorous torrent, actively rearranging and transporting its flood plain, i.e. its channel-bottom material; the stream of the covered plain is a mass of comparatively sluggish water, depositing its suspended silt on the flood-plain surface. A low-water channel is not found in typical examples of the bar plain, no doubt because it cannot exist through the flood periods. It is filled and obliterated as rapidly as it tends to form. Although such streams do not possess this channel, one may say that they are of the type that obliterates the low-water channel in time of flood, in contrast with the meandering streams, which only modify it.

Geologically Effective Floods

In a stream with low-water channel and flood plain the floods of greatest geological effect should be of two types: those that nearly fill the channel but do not overtop its banks and those that rise to still greater heights and cover the plain. Such a twofold separation of flood stages should emphasize two corresponding types of geological work: meandering and the deposition of an alluvial cover.

The meandering process consists of lateral cutting of the outer bank and deposition of a scroll, lacine, or channel bar near the inner bank. It should reach its best development where the greatest possible number of floods just fill the low-water channel, all other factors being constant. The occurrence of exceptionally great floods, covering the entire surface, changing the direction of flow in parts of the submerged low-water channel, partially filling it with debris, etc., should interfere with the regular and systematic development of meanders and consequently should be viewed as a separate process.

FIG. 7—Cross section of meander plain with alluvial cover.

An alluvial cover should have its greatest development where the maximum number of floods cover the valley plain and where the lower floods, which ordinarily cause meandering of the low-water channel, do not occur at all. Such a regimen would probably soon eliminate the channel entirely, and in this respect streams subject to these extraordinary floods would eventually resemble the bar plain described above. This reasoning leads at once to a conflict with nature, since the typical covered plain of this discussion has a low-water channel that it has maintained for a long period. A deductive examination of the different types of floods, considered as regards volume or discharge only, other factors held constant, is very complicated and is apparently not a fruitful task unless it is kept within the most elementary relationships. Various factors such as gradient, bottom load, suspended load, the mantle of vegetation, the nature of the ground water, and the nature and degree of compaction of flood-plain materials are likewise important.

Double-Crest Streams

Most flood-plain streams possess two phases of geological activity. For example, many streams build meanders during ordinary high water and also deposit an alluvial cover on the flood-plain surface during extreme stages. This combination of two phases of geological work, which has been previously described,[8] constitutes *double-crest* activity. It is to be contrasted strongly with single-crest activity, which is more rarely found.

Double-crest flood plains are usually a combination either (1) of a meander plain and a higher plain of surface deposition (*meander plain with alluvial cover*) or (2) of a bar plain and a higher plain of vertical accretion (*bar plain with alluvial cover*).

[8] J. W. Goldthwait: Physical Features of the Des Plaines Valley, *Illinois State Geol. Survey Bull. No. 11*, Urbana, 1909, pp. 84–85; C. A. Malott: The Valley Form and Its Development, *Indiana Univ. Studies No. 81*, Bloomington, 1928. On pp. 26–31 Dr. Malott describes the flood plain of lateral corrasion, which he calls the "initial" or "primary" flood plain, and the flood plain of surface deposition, which he calls the "final" or "cumulative" flood plain (p. 27).

A meander plain constructed by the shifting of the low-water channel should logically be associated with a higher plain of surface deposition; for such a cover is the natural result of the extraordinary floods occurring in most streams. The exceptional stream that rarely experiences these great floods or that, for some anomalous reason, does not deposit on the flood-plain surface during such times remains, as far as effective geological work is concerned, in the class of single-crest streams.

The covered meander plain is very common in humid regions, though even in dry climates small streams may show this combination of features. Especially good examples of this type of plain are the Santee River of coastal South Carolina and the Brazos River near Richmond, Texas (see below p. 607).

FIG. 8—Cross section of bar plain with covered plain.

The origin and even the existence of the covered bar plain may be open to dispute. Nevertheless, there appears to be an example in the plain of the Missouri River in certain parts of its course in eastern Nebraska. The writer's field experience with the rivers of the United States indicates that the surface of vertical accretion is much less common on bar plains than on meander plains and, furthermore, is usually lower and narrower. It seems natural that this should be true, since, because of the wide but shallow channel, relatively few floods can rise high enough to deposit a thick layer.

It has previously been shown that bar-plain surfaces may be aggraded or degraded and maintain at the same time those characteristics for which they are noteworthy.[9] It appears to be at least a theoretical possibility that the natural variations that beset these changes should subject certain parts of the flood plain to the influence of high water oftener than others. In a degrading bar-plain stream, or even in streams whose surface is temporarily stable, those parts of the channel bottom least affected by ordinary floods might become the site of surface deposition during floods of unusual height.

The immediate cause may, however, be other than that just proposed. Consider the Colorado, the channel of which resembles a bar plain at the points of greatest width and curvature. Any covered bar meander plain of this extreme type would assume at least the outward appearance of a covered bar plain if the narrower parts of the uneven channel were to be widened and straightened and were to maintain such a course, though perhaps sweeping from side to side, for a considerable time. Channel straightening of a meandering stream might *result* from a steepening of the flood plain by tectonic means; it would, of course, *produce* a steeper gradient of the low-water channel. There

[9] N. M. Fenneman: Physiographic Provinces and Sections in Western Oklahoma and Adjacent Parts of Texas, *U. S. Geol. Survey Bull. 730–D*, 1922, p. 131.

FIG. 9

FIG. 10

FIG. 9—The flood plain of the lower Brazos River in coastal Texas. A narrow meander plain is being developed at the expense of the higher silt-covered portion of the flood plain, which is shown here by the cultivated land. A meander plain with covered plain. (Fairchild Aerial Surveys, Los Angeles.)

FIG. 10—Part of the flood plain of the Missouri River in northeastern Nebraska. The channel bottom of ordinary floods is a bar plain (the plain of a "braided" stream). A higher plain of surface deposition, underlying the farm land at the left, in 1881 was raised from 4 to 6 feet during a single extraordinary flood. (Fairchild Aerial Surveys, New York.)

FIG. 11

FIG. 12

FIG. 11—The dominant meander plain of a small stream east of the Kettleman Hills, in King County, Cal. The stream's activity in raising the level of its alluvial valley by deposition during extraordinary floods is at present subordinate to the meandering. (Fairchild Aerial Surveys, Los Angeles.)

FIG. 12—The "normal" flood plain of the Boeuf River near Mason, Franklin Parish, La. Both meandering and vertical accretion take place, neither process offering much resistance to the other. Meander scrolls may be seen near the channel in spite of the heavy vegetation. Farther away they are entirely covered. (Fairchild Aerial Surveys, Los Angeles.)

are numerous indications that a covered bar meander plain may be changed into a covered bar plain. Other variations in a stream's regimen than that of steepened gradient, however, may be important in causing the change; for example, variations in the frequency of torrential precipitation or variations in contributed load.

Exceptional Combinations

In addition to its localized bar-plain characteristics, the Missouri River at certain other localities in eastern Nebraska possesses a covered plain through which the low-water channel meanders in broad loops similar to those of the lower Colorado. Where this occurs, the alluvial land is to be considered a meander plain with a higher covered plain.[10]

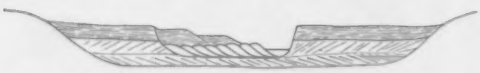


Fig. 13—Cross section of meander plain with dominant covered plain.

The Little Colorado River above Grand Falls exemplifies a covered scroll meander plain with a new phase of activity, consisting merely of the building of a bar plain. In this case the change has probably been due to a variation of the climate, whereby the vegetation cover in the surrounding region has been reduced and the stream has been loaded with an unusually large amount of debris.[11]

Dominant Processes in Double-Crest Streams

There are many cases in which the deposition of the alluvial cover does not take place rapidly enough to overcome the capacity of the low-water stream to meander, and there are others in which the meandering does not occur so rapidly as to cut away the higher plain as fast as it is formed. The classification accordingly must be enlarged to describe the relative vigor of the two phases of double-crest activity: (1) the building of a meander plain or a bar plain and (2) the deposition of an alluvial cover.

In many streams a meander plain meets the higher plain with a sharp contact at steep banks. In such a stream the meandering activity is vigorously expanding and is cutting away the higher plain, which is, nevertheless, occasionally flooded. The areal growth of the alluvial cover has ceased, at least temporarily, and it is yielding ground to the meander plain of lower level. Isolated, discontinuous relics of natural levees may be found, but a continuous levee cannot exist. Though various conditions might cause a meander plain to expand

[10] For reasons already explained it seems better not to use the term "bar plain" where the low-water channel meanders to noteworthy extent, even though the channel may be decidedly braided during low water. The term "bar meander plain" is suitable for such a case.

[11] H. E. Gregory: Geology of the Navajo Country, *U. S. Geol. Survey Professional Paper 93*, 1917, pp. 117–132.

thus at the cost of the covered plain, the commonest is probably valley deepening. With the mean flood height lowered, the stream is no longer able to build the higher surface with such vigor as formerly. In streams of this type the meander plain dominates the covered plain. Among the numerous known examples which are known, the lower Brazos in coastal Texas is especially clear.

Where both the meandering activity and the deposition of an alluvial cover are taking place, though without noticeable undercutting of the higher plain and without obvious hindrance to the meandering, neither process dominates the other. The alluvial cover on the flood-plain margin thins out gradually toward the lower plain, on the surface of which it disappears, natural levees being entirely lacking. The deposited layer thins toward that part of the flood plain that experiences the meandering process most frequently; in fact, it grows, subject to the limitations imposed upon it by the meandering. It seems fitting that this balanced condition should be thought of as the normal case of a double-crest stream. It is found only where the flood plain is considerably wider than the meander belt. Such a balance, if it is "normal," need not be specially recognized in a system of nomenclature but may be tacitly understood. The Ouachita and Boeuf Rivers in Franklin and Catahoula Parishes, Louisiana, are two examples of this class.

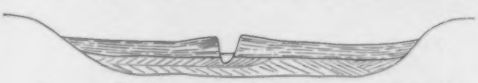


FIG. 14—Cross section of single-crest covered plain.

Where surface deposition takes place so rapidly that the meandering, although it continues to occur, is slowed down and restricted in degree, the covered plain may be said to dominate the meander plain. Such appears to be the case with the Santee, though a dense growth of trees on the low flood plain may also be a factor.

If for any reason the rate of channel shifting is markedly reduced, natural levees appear as a result of the deposition of the alluvial cover. Various factors may operate to reduce the rate of meandering; for example, compaction of flood-plain materials by the incumbent load; induration due to the deposition of a "bond";[12] or, possibly, channel-bank slumping from a rapidly growing covered plain. The last-named process may even be adequate to stop the growth of meanders on strongly leveed streams. Where levees are well developed, they are prevailingly wider on the outer bank of channel bends than on the inner, a condition which is no doubt due to the greater age of the outer levee. It seems possible in the case of small streams that an excess of slumped material from the outer as compared with the inner bank may so exceed the corrasive capacity of the low-water stream that the *thalweg* remains permanently near the inner bank.

It is apparent that an increase of over-bank floods and, conse-

[12] Matthes, *op. cit.*, p. 428.

quently, a rapidly growing alluvial cover should cause a meander plain ultimately to acquire those characteristics that have previously been assigned to single-crest covered plains. In so doing it passes back into the class of single-crest streams. Even though the alluvial cover of strongly leveed single-crest streams frequently overlies the scrolls and

FIG. 15—The flood plain of the Santee River near Ferguson, S. C. The covered plain dominates the meander plain. The meandering activity is restricted, and its visible signs (scrolls and lacines) are concealed except near the channel. (Courtesy of the U. S. Forest Service.)

lacines of a meander plain, nevertheless, in constructing a system of descriptive terms it seems best to ignore the buried plain and to emphasize the process that by its overwhelming influence brought meandering to a stop.

The Santee River is an example of a *scroll meander plain with dominant cover*.[13] The Brazos flood plain near Richmond may be described as a *dominant scroll meander plain with covered plain*.[14] Wherever the writer has seen a bar plain with a higher covered plain, the low-level surface appears to be dominant and to be expanding its activity. Such is the case with the Missouri River in northeastern

[13] It is apparent that terms such as these do not furnish a complete picture of all the important conditions. For example, the relationships of width of low-water channel and flood plain are also important. Other systems of classification are available, however, to complete the description.

[14] Where the meander plain is dominant, one cannot determine without excavation whether a meander plain or a bar plain was previously covered by the silt deposition. The same holds true of a bar plain that is expanding its activity at the expense of a covered plain. This uncertainty should be reflected in the name assigned, as in the case above. An unjustifiable assumption would be made if the lower Brazos were described as a *dominant scroll meander plain with alluvial cover*.

Nebraska: during ordinary floods the stream undercuts the higher plain at the same time that it builds a bar plain in the channel. Notwithstanding this fact, in 1881, during a single remarkable flood this river is reported to have raised the level of its covered plain four to six feet.[15] This flood plain may be described as a *dominant bar plain with covered plain*. The Mississippi below Baton Rouge is a *single-crest covered plain*.

Limitations of the Classification

In this system the recognition of stream terraces is considered unimportant, because it is usually impossible to say whether or not a given flood-plain shelf will again be submerged. The system eliminates streams without definite alluvial plains as well as those with flood plains "ready-made," such as streams consequent on a flat lake bottom. It also eliminates conditions that are clearly accidental, such as older flood-plain remnants above a younger incised stream. Relatively small streams flowing on the flood plains of larger ones have no definite place in the system. Some of these are consequent on the plain surface; others have originated through accidental cause.

The classification of flood plains, and therefore of streams, is made difficult by the effects of wind, tributaries, sheetwash, and the processes of weathering. These tend to obscure the surface features of meander plains and especially of bar plains. Though a flood-plain shelf, isolated by channel deepening, may yet receive the deposit of a superflood on its surface, it may in time resemble a covered plain merely through the effects of weathering. A search for fresh exposures of the alluvium and the use of a soil auger are necessary in a careful application of the system. Although it may profitably be used as an addition to older methods, it does not supersede those based on conditions such as the relative width of low-water channel and flood plain.

It is perhaps a limitation but not a fault of the proposed method that it must be applied locally. Most streams change so rapidly from place to place that simplified regional descriptions are apt to be incorrect. Any attributive system must face this difficulty.

As in the case of most classifications this one is applied to a series of related features that themselves vary and that grade from one type into another. It is believed, however, that boundaries consistent with nature have been chosen in every case. In fact, the classification was the result of necessity, while an attempt was being made to correlate the known features of many different streams. Although other types of flood-plain activity will be described, the commonest are without doubt included in the system here presented.

[15] B. M. Harrod and C. R. Suter: Report of the Committee on Outlets and Levees upon the Floods of the Missouri River in the Spring of 1881, *47th Congr., 1st Sess., Senate Ex. Doc. No. 10*, Part 1, 1881, pp. 135–139 (App. H).

A SOUTHWESTERN OASIS: THE ROSWELL REGION, NEW MEXICO*

Ralph H. Brown
University of Minnesota

FIG. 1—The situation of Roswell.

One of the more remarkable of this country's artesian basins, lying just west of the Pecos River in southern New Mexico, has, since the turn of the century, been known as the Roswell artesian basin, deriving its title from the state's second largest city. The present flow area, smaller than when first surveyed by Fisher[1] in 1904, is confined to a narrow belt roughly parallel to the Pecos for 60 miles. The irrigated area is narrower still; and it is not continuous from end to end. In reality the basin is divided into half-a-dozen segments recognizable by cultural features and separated from one another by unirrigated areas. The Roswell region, the largest and most representative of these segments, is that part of the basin which is tributary to the city. It includes some hundred square miles of productive land irrigated chiefly from flowing artesian wells. As a region it is likewise distinguished by compact settlement, varied racial stocks, and a general maturity of cultural development.

SALIENT FEATURES OF THE AREA

Viewed as if from aloft at a considerable elevation (Fig. 2) the region appears as a strip of verdure between the Pecos River and the western highlands. The green belt, close to the river in the foreground, trends away from it toward the northwest where, in the near distance, Roswell marks the approximate limits of recoverable flow. Beyond Roswell the surface rises gently but persistently to a limestone upland, often but inexactly called a plateau, which finally culminates in the imposing heights of the Capitans and the Sierra Blanca.

This trans-Pecos highland country forms the area of intake into the artesian basin. The cavernous Picacho limestone, exposed in the intake area and overlain downslope by the Pecos formation, is primarily significant in the absorption of precipitation and its underground concentration. The structure section, adapted from Fiedler

*The field work on which this study is based was made possible by funds granted for that purpose by the Graduate School of the University of Minnesota.

[1] C. A. Fisher: Preliminary Report on the Geology and Underground Waters of the Roswell Artesian Area, New Mexico, *U. S. Geol. Survey Water-Supply Paper 158*, 1906.

and Nye,[2] indicates that the region is more properly referred to as an "artesian slope" than as an "artesian basin." The average level of the water table, deep beneath the surface of the high country, rises toward the east, cutting across the various formations and finally intersecting the surface beyond the Pecos. Here, beneath the Pecos bluffs, are numerous water-filled dolines, early named and still called "Bottomless Lakes," which were recently set aside as a state park. A boring into the Picacho, however, is no assurance that a flowing well will result. Within the present area of artesian flow 70 per cent of the 400 used wells[3] flow naturally. Fifty of these are provided with pumps to increase natural flow, and a few, flowing naturally in winter, need pumping during the summer season of excessive draft on the artesian sources. Other artesian wells need pumping at all seasons. In addition to the wells penetrating to the artesian sources, there are numerous shallow ground-water wells, in which water is lifted to the surface by fuel pumps as well as by windmills. Within the same small district, perhaps on the same farm, may be found representatives of all these kinds of wells. On a summer's day or night one is rarely beyond earshot of the dull roar of Diesel engines or, in any season, out of sight of the ubiquitous pump house.

The main lines of the culture pattern are formed by the familiar rectangular road system that bespeaks the low relief of the area. The regional slope, necessarily exaggerated in the diagram, is from the northwest toward the southeast: the altitude in the foreground is 3460 feet; Roswell, ten miles distant, is only 105 feet higher. The blank patches interrupting the otherwise continuous irrigated area are rough lands bordering the excessively meandering Rio Hondo and its uncertain tributaries, the Berrendo and the North and South Spring Rivers. Of these streams the Hondo is the longest, being formed by two mountain sources, the Ruidoso and the Bonito. North and South Spring Rivers, rising very near Roswell and formerly well supplied with natural springs at their heads, were largely influential in localizing settlement.

A large-scale perspective view of the Roswell region reveals the essential simplicity of the pattern of natural and artificial watercourses, roads, railroads, the city, and boundary fences, faithfully represented without attempt at simplification in Figure 3.

Inherited Cultural Features: The "Ranches"

Numerous relic cultural forms are preserved in the present landscape (Fig. 3). Some of these are identified at points *G* and *H*. This is the South Spring area, where abundant clear water originally

[2] A. G. Fiedler and S. S. Nye: Geology and Ground-Water Resources of the Roswell Artesian Basin, New Mexico, *U. S. Geol. Survey Water-Supply Paper 639*, 1933.

[3] *Ibid.*, Pl. 39 (map showing location of artesian wells).

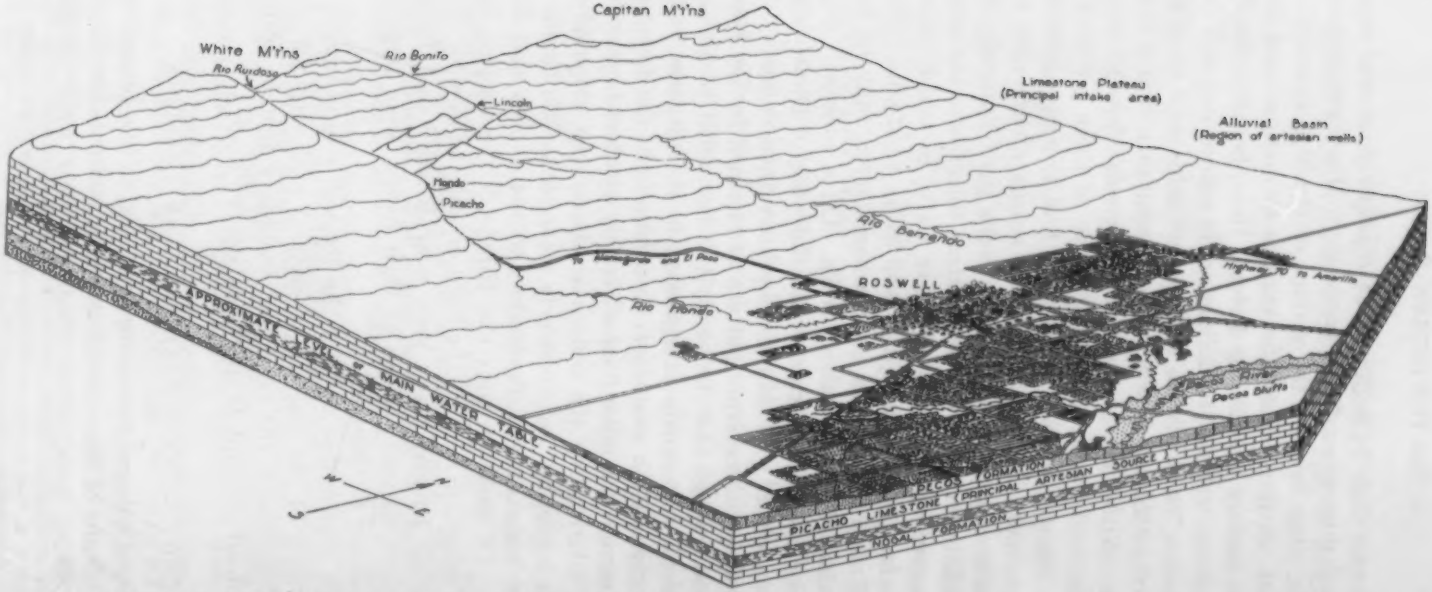


FIG. 2—Regional diagram of the Roswell artesian basin and related part of the trans-Pecos highlands.

For a discussion of this mode of illustration see the author's paper "On the Merits of Regional Diagrams in Field Reports" in the *Annals of the Association of American Geographers*, Vol. 25, 1935, pp. 75–83. The term "regional diagram" was used by Isaiah Bowman in 1916 for "a kind of generalized type map," which he used in illustration of different regions (eight in number) of the Andes of Southern Peru: the regional diagram "bears somewhat the same relation to the facts of human geography as a block diagram does to physiography" (The Andes of Southern Peru, 1916, p. 51).

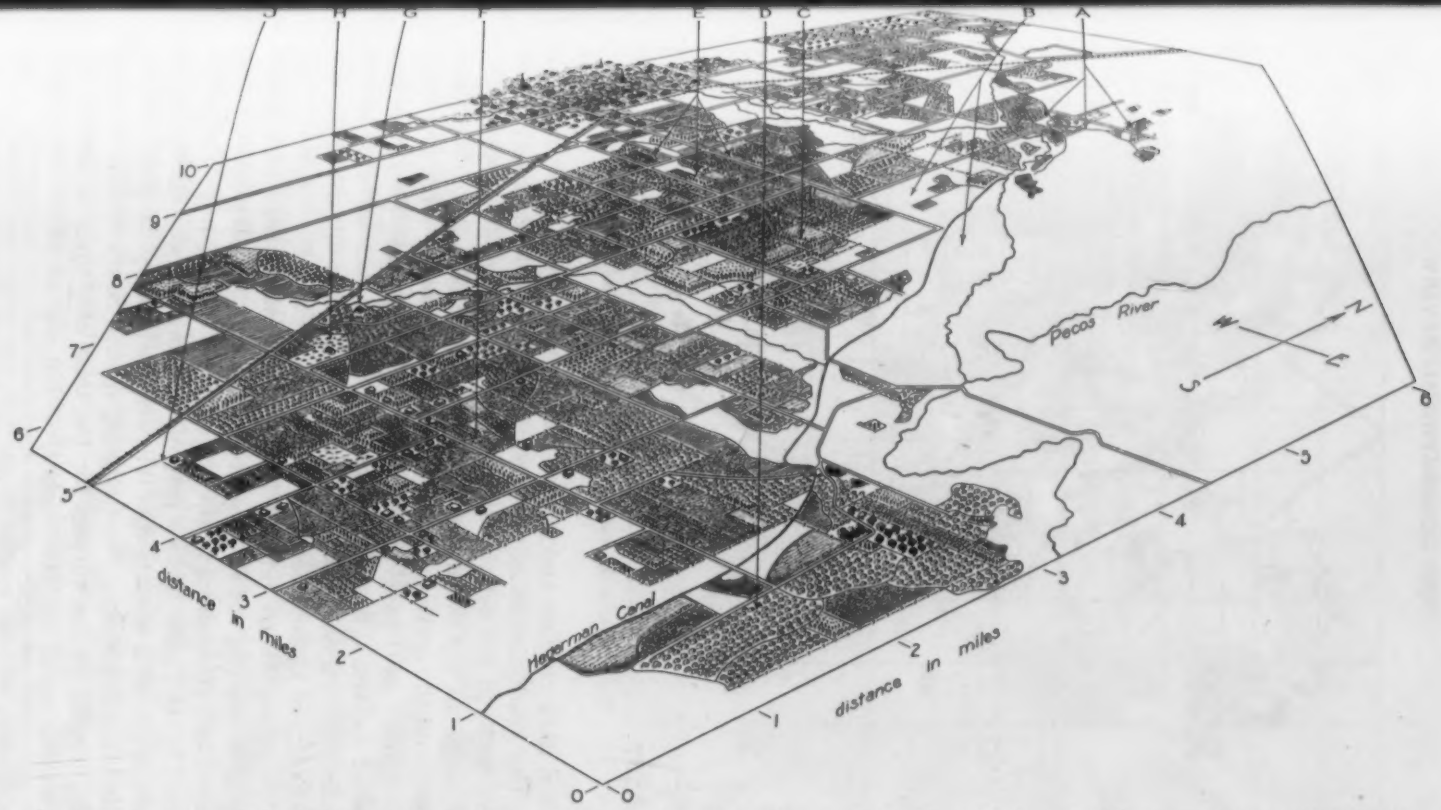


FIG. 3—Perspective view of the Roswell region (compare Figs. 2 and 4 and 5). Letters have reference to points discussed in the text and illustrate: A, an area entirely dependent on surface water; B, a decadent area (compare Fig. 7); C and D, farms of above average size (D is the Oasis Ranch whose famous flowing well is pictured in Fig. 8); E, area of most intensive land utilization; F, the productive East Grand Plains district; G and H, relic cultural forms in the South Spring area; J, sharp contrast between irrigated land and never-tilled land shown in Figure 6.

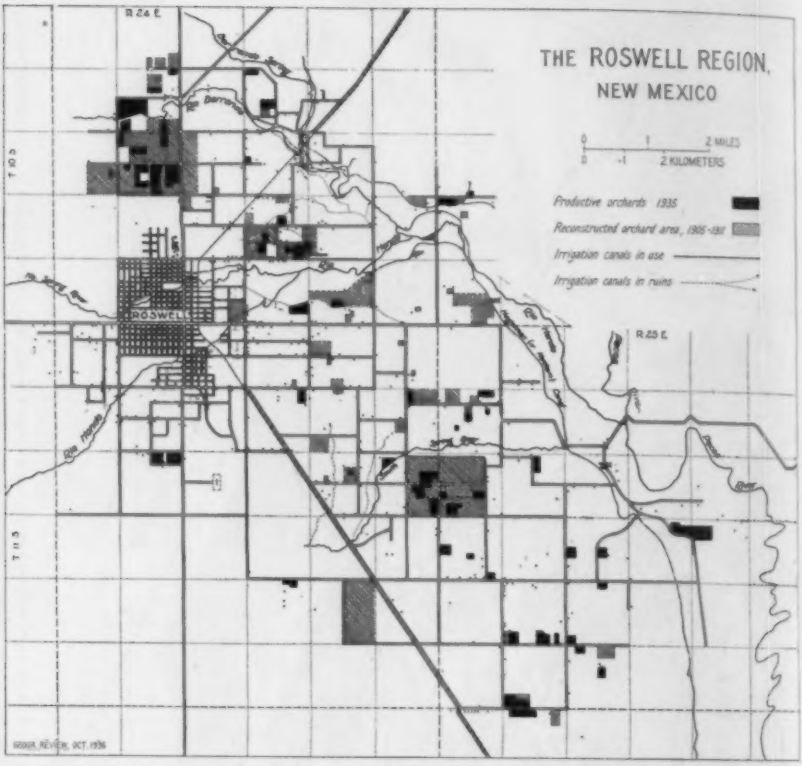


FIG. 4—Map of the Roswell region showing the decline in orcharding.

welled to the surface and invited its selection in the 1860's as the site for the headquarters of the great Chisum cattle company. Here were centered the activities of a ranch that originally controlled all the range up and down the Pecos for a hundred miles, from Bosque Grande on the north to Seven Rivers on the south.[4] The first irrigation ditches in the region headed at South Spring. They have been unused for years, but their lines may still be reconstructed by connecting the various links made visible by partly filled trenches and rows of giant cottonwoods.

Other cattlemen pressed in on the Chisum range and selected similar sites along the Pecos or its tributaries. Conflict over the range ensued and culminated in the so-called Lincoln County War (at this time Chaves County was a part of Lincoln). It was during the two years of guerrilla warfare that followed that "Billy the Kid" achieved widespread notoriety. North Spring rivaled South Spring as a water hole, serving as the nucleus for the then cow town of Roswell and furnishing water for five ditches, all but one of which are today in

[4] Historical information regarding the open-range cattle industry was obtained largely from J. F. Hinkle of Roswell, a former governor of New Mexico.

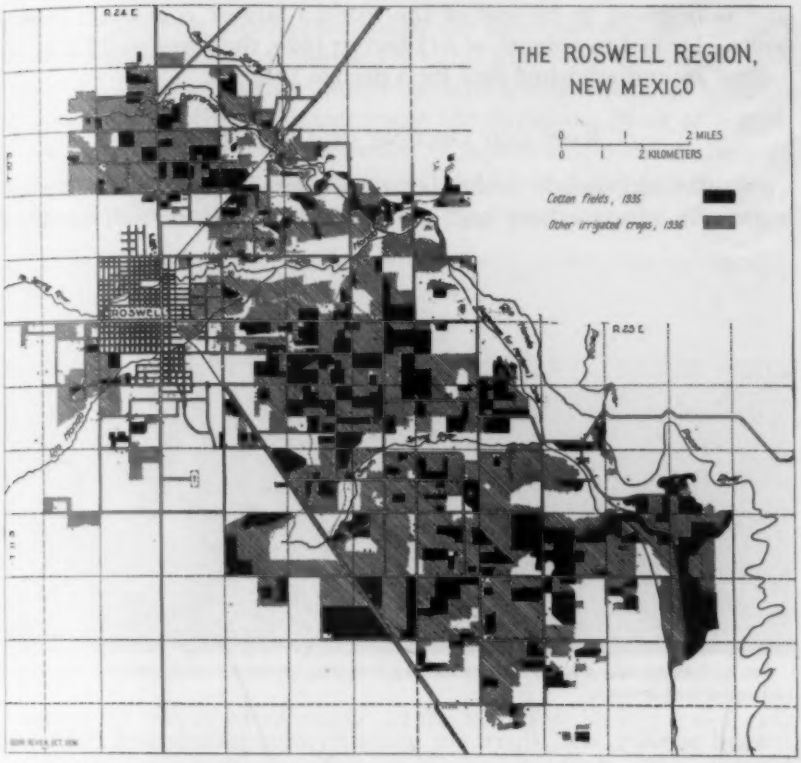


FIG. 5—Map of the Roswell region showing the comparative importance of cotton among the irrigated crops.

ruins, so long unused that few recollect their locations and fewer still their names. The Hagerman Canal, in the foreground, which waters lands south of the Roswell region but none within it, definitely belongs to a later period.

Large landholdings are, therefore, traditional in the Roswell region. South Spring Ranch (point *G*), now owned, by a curious twist of circumstances, by Cornell University, still preserves in its large fields and its commodious manager's home something of the atmosphere of old times. Point *C* directs attention to another farm above average in size—the remnants of the once-vast Littlefield or L. F. D. ranch. Another example is indicated by point *D*, which is centered upon the Oasis Ranch. Including two square miles of land watered principally by one locally famous well, its fields contain all the crops typical of the entire region and in their approximate proportions. Cotton takes first place, followed by hay and cane for forage, small grains, corn, orchards, and garden truck. The Oasis well—*noria grande* to the Mexicans who work upon the estate—is remarkable for its astounding flow of nearly 6000 gallons a minute

and is believed to be one of the world's largest cold-water flowing wells. Drilled to a depth of 617 feet in 1926, the Oasis well has maintained an undiminished flow for a decade (Fig. 8).

Rise and Decline of Orcharding

Apple and peach orchards are scattered through the Roswell region, in clusters here and there. Nearly all are well advanced

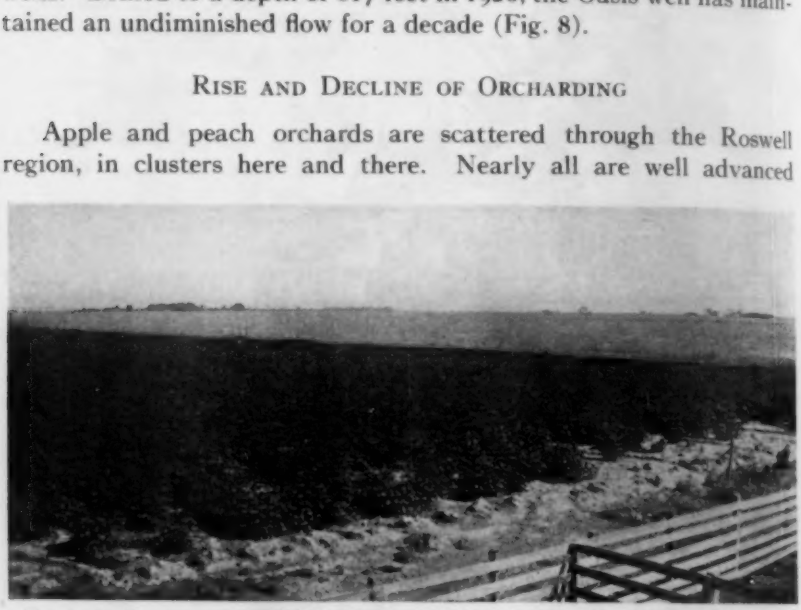


Fig. 6—Looking over a cotton field to the steppe (J, Fig. 3): the boundary between irrigated and unirrigated land is sharp.

toward senility, and there are many dying orchards and fields containing either dead trees or their stumps. Obviously the present orchards are merely remnants of former larger ones. The present and the reconstructed orchard areas are shown in Figure 4.[5] The large orchards of the period 1905 to 1911 were one of the accompaniments of the period of change that came with the development of artesian water, indeed one of the few features of that period still visible in the landscape. The original well proving the artesian flow was drilled in 1891. By 1900 more than a hundred wells were in operation. Fruit raising appealed to owners of large acreages as a suitable use for these supplies of water obtained at a rather high cost. South Spring Ranch set the example by planting a 600-acre orchard. After its profitable sale of a trainload of fruit in 1905 the setting out of orchards became the order of the day, but within the decade many signs appeared foretelling the eventual decline of horticulture. Apple and peach trees becoming less productive with advancing age or from attack by insect pests or prematurely killed by salty water or by indifferent care were not replaced with younger trees. Opinions differ regarding the causes leading to the decline of orcharding. By some it is ascribed to winter freezing, especially the all-time low of −29° F.,

[5] The principal collaborator on this map was Mr. Arthur J. Stevens of Ingleside Farm, former artesian-well supervisor.

which prevailed for 50 minutes during the early morning of February 13, 1905, and the freeze of January 8, 1913, when −19° F. was officially recorded. Others consider numerous late spring frosts as of more importance; and still others emphasize the damaging effect of aphids, or coddling moths, or the penetration of taproots into the underlying gypsum. Whatever the causes, several dead and dying orchards were pulled up after 1915—a process not yet complete—and the wood

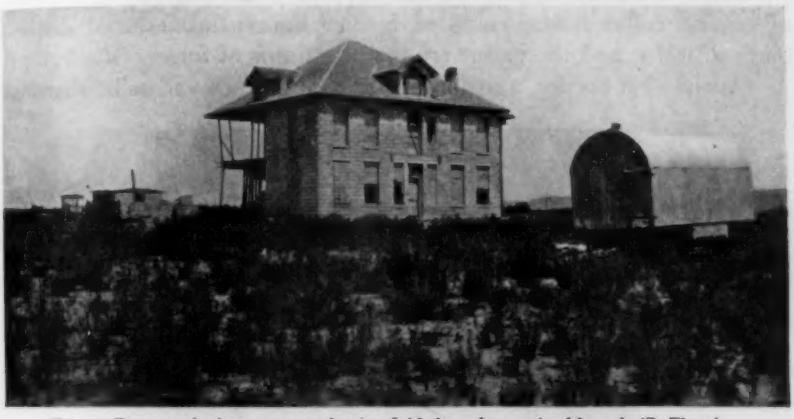


FIG. 7—Farmstead whose once productive fields have been ruined by salt (B, Fig. 3).

was used for fuel or fence posts. In the fields left vacant a new crop was planted, hailed as the final answer to regional problems of land use. This crop was cotton—Acala long staple.

CONTRASTS IN CULTURE PATTERNS

Contrasts in patterns may also be recognized in the perspective view (Fig. 3). Point *F* is centered upon the district locally known as East Grand Plains, whose productive fields include most of the area south of South Spring River. This is the largest extent of level land in the Roswell region. Inasmuch as the area is watered exclusively from artesian wells drilled on the higher side of fields, long farm-to-farm ditches are unnecessary. Rectangular fields predominate, since the short ditches, heading at the well or wells, customarily follow roads, fences, or other survey lines. By way of contrast, point *A* designates an area entirely dependent on surface water, taken from Berrendo Creek. The main lines are formed by ditches diverting water from the creek at short intervals. The failure of several artesian wells in this northern district has caused a reversion to the creek-and-ditch irrigation of the preceding period. The area irrigated in this manner is small, however, fully 90 per cent of the irrigated land in the Roswell region being watered from artesian sources. Point *E* draws attention to a third type of pattern. This is the area of most

intensive land utilization, along the Lubbock highway, which, in Roswell, becomes one of the two principal business streets. The area is one of dense population, small farms, and tiny fields used for a variety of purposes, especially for garden truck and dairy production.

Peripheral Areas of Decline

Areas of decline appear on the borders of the region—in the form of gaping cellar holes, ruins of former houses, abandoned ditches, plugged wells, and the gaunt trunks or stumps of former shade trees.

On the west border, a region of excellent surface and soils, abandonment has resulted from the failure of several artesian wells. A quarter of a century of unregulated drilling has caused a marked reduction in the stored supply and in hydrostatic pressure. The time interval elapsing between the failure of a flowing well and the abandonment of the fields watered from it is usually lengthened by pumping. Granted a moderate "lift" the venture may still prove a profitable one despite high costs of pumps and their upkeep. Inevitably, however, the west fringe of the irrigated area creeps downhill and now fairly cuts across the city. Further abandonment may be checked by well regulations recently enforced by the state.

Fig. 8—The Oasis well (D, Fig. 3).

On the lower, or east, side of the region the principal cause of recession has been the increasing salt content of the well water. This situation is also believed to have had its origin in overdrafts on the water resources. Point *B* localizes the area that has suffered most severely, and Figure 7 shows a once-productive farmstead in this area. A 25-year cycle, from livestock to livestock, is recorded in the presence of the sheep wagon in what was a pleasant, shady dooryard. Since the scene was photographed, the ruins have been partially restored preparatory to an expected early return to surface-water irrigation, from a ditch leading from the near-by Rio Hondo.

Greater still are the contrasts between the irrigated area and adjacent land never tilled. There is usually no transition, merely a fence or a road where two utterly different cultural landscapes meet. Point J indicates one of many such boundary lines. From a convenient silo at this point Figure 6 was taken, a cotton field ending abruptly at the steppe. In the far distance an island of green indicates an isolated group of artesian wells.

Long-Staple Cotton Now Supreme

The Roswell region has evolved from a livestock range country through a brief period of experimentation in fruit culture to a more

Fig. 9—A glimpse of the Roswell region.

diversified irrigated-crop oasis—in this instance an *artesioasis*—in which cotton, at least momentarily, is supreme. Cotton fields in 1935 are indicated by the black areas in Figure 5. Although 1935 was a cotton-reduction year, cotton occupied fully 40 per cent of the cropland.

The oasis character of the Roswell region is confirmed by the impression that one carries away of its lush fields and groves of trees and its roads tunneling through the cottonwoods and willows. Because of this arboreal growth and the prevailing flatness of the surface favorable scenes for photography are rare. Figure 9, however, may serve as a parting glimpse of the region.

THE DIVERSITY OF NEW YORK CITY

COMMENTS ON THE REAL PROPERTY INVENTORY OF 1934*

John K. Wright

COUNTLESS pictures and descriptions have made all the world familiar with the stupendous sky line of southern Manhattan's skyscrapers. The island's opposite end, some fourteen miles to the north, is totally different in aspect. There Manhattan terminates at the foot of a pleasant wooded hill, unmarred until recently[1] by man-made structures and suggestive even today of the wilderness that once covered the whole region within the present city limits.

This contrast symbolizes the diversity of New York. So varied is the physical structure of the city, so complex is its life, so rapid are the changes taking place from day to day that no geographer has yet ventured on a detailed study of this mighty community.[2] Material is not wanting, however, on which a comprehensive geographical monograph could in part be based. The Regional Plan of New York and Its Environs[3] and the volumes on population[4] edited by the late Dr. Walter Laidlaw have already been noted in this journal,[5] and to the abundance of information that they offer may now be added the reports and maps of the Real Property Inventory of the City of New York taken in 1934.[6]

Growth of the City and Land Utilization

The Inventory shows that in 1934 about 60 per cent of the 198,330 acres (310 square miles) of land in the whole city was used for residential purposes, approximately 10 per cent was in "permanent open

*The American Geographical Society and the author wish to thank the New York City Housing Authority for the donation of maps and for other courtesies in connection with this article.

[1] A great steel bridge that will span Spuyten Duyvil Creek is now being constructed there.

[2] F. V. Emerson's "A Geographic Interpretation of New York City" (*Bull. Amer. Geogr. Soc.*, Vol. 40, 1908, pp. 587–612 and 726–738; Vol. 41, 1909, pp. 3–21) deals almost exclusively with the situation of New York in relation to the larger geographical features of the northeastern United States. A. G. Ogilvie's "New York and Its Region" (*Geography*, Vol. 15, 1929–1930, pp. 199–214) is a short study by a British geographer whose was formerly a member of the staff of the American Geographical Society. A paper on "The Water Barriers of New York City" was contributed by Ellsworth Huntington to the *Geographical Review*, Vol. 2, 1916, pp. 169–183. A popular illustrated article by Frederick Simpich, "This Giant That Is New York," was published in the *National Geographic Magazine*, Vol. 58, 1930, pp. 517–583.

[3] Regional Survey of New York and Its Environs, 8 vols. (Vol. 1 in 3 vols.), New York, 1927–1931; Regional Plan of New York and Its Environs, 2 vols., New York, 1929 and 1931; From Plan to Reality: A Report of Four Years' Progress on the Regional Development of New York and Its Environs . . . . Regional Plan Association, Inc., New York, 1933.

[4] Statistical Sources for Demographic Studies of Greater New York, 1920, The New York City 1920 Census Committee, Inc., New York, 1922; Population of the City of New York, 1890–1930, Cities Census Committee, Inc., New York, 1932.

[5] *Geogr. Rev.*, Vol. 20, 1930, pp. 323–326; Vol. 24, 1934, pp. 136–137.

[6] See Appendix below.

spaces" (parks, playgrounds, cemeteries, etc.), 10 per cent was used for "non-residential" purposes, and the remaining 20 per cent was vacant.[7]

One might expect the built-up areas of a city to assume the shape of an expanding star rather than that of an evenly enlarging circle. Transportation lines radiating from the business heart form central arteries along which the arms of the star grow outward. New buildings are first constructed near these main arteries, and only later are the gaps filled in. A city built on a flat, featureless plain ought to show a more nearly perfect starlike form than one occupying a more varied site. In the latter case the arms of the star become elongated along lines where the terrain offers the least resistance to roads, railroads, and rapid-transit routes and are blunted where growth is checked by natural or artificial obstacles. Hilly, rough, and marshy land long remains vacant; part of it is set aside early in the city's growth as "permanent open spaces," and the remainder is not built upon until pressure of population and the need for more room justify the expense of streets, sewers, gas, electricity, etc. Marshes, costly to drain and reclaim, are developed last of all.

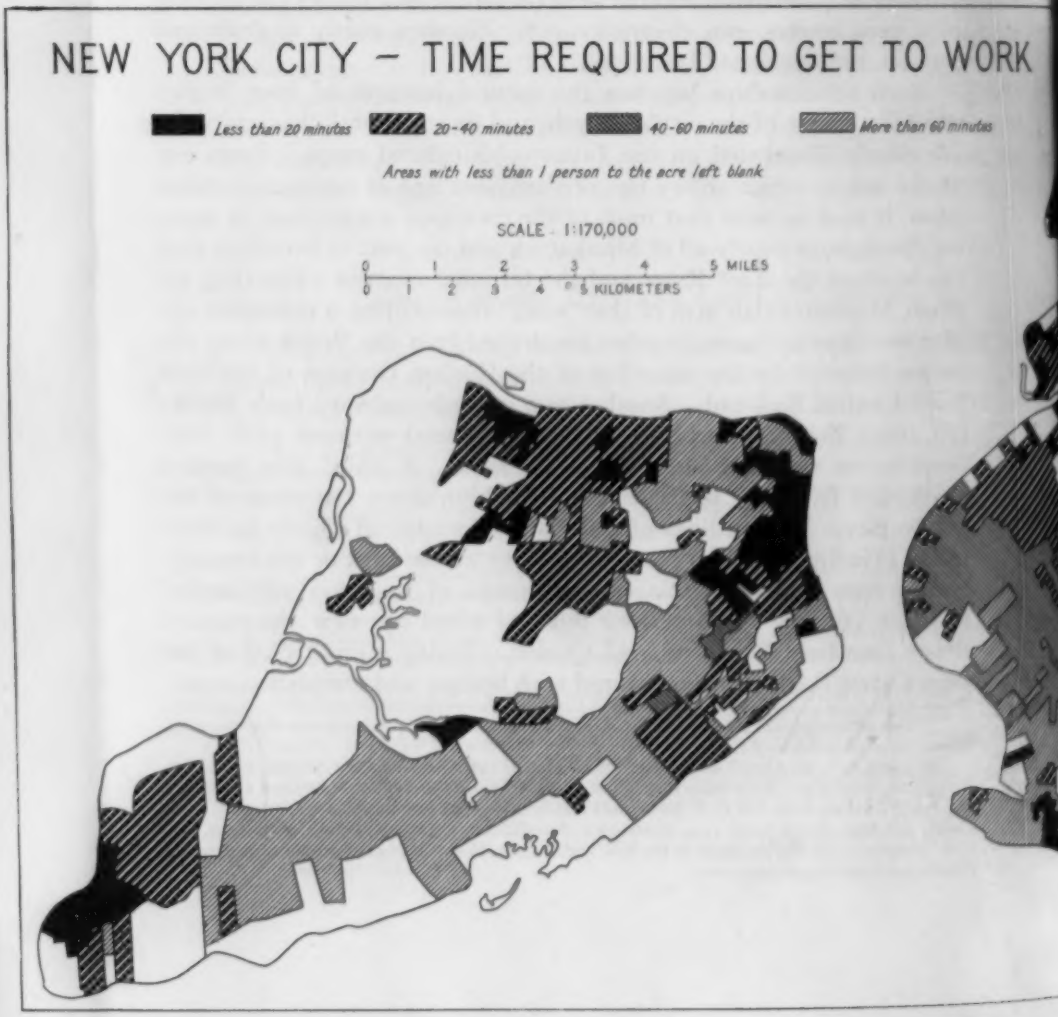
Such relationships between the natural features of New York's site,[8] the course of the city's growth, and its structural characteristics are clearly illustrated on the Inventory's colored maps. From one of the maps, which shows the predominant age of residential structures, it may be seen that most of the dwellings are at least 35 years old throughout nearly all of Manhattan and the part of Brooklyn that lies between the East River and the terminal-moraine ridge (Fig. 1). From Manhattan an arm of the "star," representing a prevalent age of more than 35 years, reaches northward into the Bronx along the valley followed by the main line of the Harlem Division of the New York Central Railroad. Another arm extends eastward from Brooklyn along the north margin of the flat glacial outwash plain that borders the terminal moraine on the south. A third arm reaches southward from the older part of Brooklyn along the shore of the Upper Bay. The outlines of these arms correspond closely to those of the principal built-up parts of the city at the turn of the century. Before 1900 scattered villages and groups of buildings surrounded by open country characterized most of what are now the eastern Bronx, southern Brooklyn, and Queens. Today a great deal of the then vacant land has been covered with houses, and the predominant-

[7] These percentages are taken from a summary report of the Mayor's Committee on City Planning, figures corrected to January 1, 1935.

[8] Consult F. J. H. Merrill and others: Description of the New York City District, *U. S. Geol. Survey Geol. Atlas of the United States Folio No. 83*, 1902; Regional Survey, Vol. 8, Physical Conditions and Public Services, 1929; and C. P. Berkey and others: New York City and Vicinity, *Internatl. Geol. Congr., 16th Sess., United States, 1933, Guidebook 9*, Washington, 1933. A. K. Lobeck, E. J. Raisz, and R. L. Dickinson: The Physiography of the New York Region, New York, 1930, contains physiographic diagrams with brief explanatory text.

FIG. 1—Identification map of New York City. The areas of salt marsh as shown here, from the topographic sheets (1 : 62,500) of the U. S. Geological Survey, are based on surveys made before 1900. Some of the marshes have been filled in since that date.

FIG. 2—Map of New York City showing the approximate time required by income earners to get to their places of work, 1934. Compiled from statistics in Real Property Inventory, City of New York, Residential Report, 1934, in which the income earners are classified in four time groups; the map shows the time group that predominates in number in each census tract. Areas having fewer than one person to the acre and the islands of the East River, where most of the people are inmates of public institutions, are left blank.


NEW YORK CITY – TIME REQUIRED TO GET TO WORK
Less than 20 minutes
20-40 minutes
40-60 minutes
More than 60 minutes
Areas with less than 1 person to the acre left blank
SCALE - 1:170,000
0 1 2 3 4 5 MILES
0 1 2 3 4 5 KILOMETERS

N

age map shows each of the arms incased, as it were, with successive zones of newer structures. The outlying villages have expanded and coalesced, and the main mass of the city has grown to such a degree that few built-up areas within the city limits are today completely isolated by open land. The 20 per cent of vacant land in New York in 1934 was largely salt marsh (as may be seen when the Inventory maps are compared with the topographic sheets of the U. S. Geological Survey, which show marshes). Except for marshes, parks, and cemeteries, there are now only two areas of vacant land of any considerable extent: in eastern Queens and in central and southern Staten Island. Both are far from the business centers, and both are on or near the ridge of the terminal moraine. The shaded areas on Figure 2 correspond approximately to the built-up areas of the city.

The distribution of "permanent open spaces" also shows—in certain parts of the city, at least—a definite relationship to the configuration of the ground. The plan of New York of 1811, which established the gridiron pattern of streets in Manhattan, has often been criticized because it took little account of the relief features of the island. "If Upper Manhattan and The Bronx have boulevards and parkways which are pleasantly related to the features of the terrain and which accord well with the general street plan, it is largely due to the intelligence and care with which Andrew H. Green and his associates, including the elder [Frederick Law] Olmsted, discharged the duties that were entrusted to them" in the sixties and seventies of the nineteenth century.[9] In upper Manhattan a line of narrow parks extends northward from the northwest corner of Central Park almost to the end of the island (Fig. 3). These parks were laid out in such a way as to include a pronounced and picturesque rocky slope that bounds Morningside Heights and Washington Heights on the east and falls away to the flats of Harlem and, farther north, to the deep cleft of the Harlem River valley. Another broken line of parks and cemeteries marks the terminal moraine in Staten Island and Long Island.

"Non-Residential" Areas

The distribution of the city's 10 per cent of "non-residential" land (i.e. non-residential land that is neither in permanent open spaces nor in vacant blocks) also may be explained partly with reference to natural features. Narrow zones along the water fronts of the East and Harlem Rivers, the Upper Bay, and the Hudson south of the center of Manhattan are given over to non-residential uses. A rough estimate shows that about half of the entire water front of New York City is fringed with warehouses, docks, factories, and institutions. Long, branching tongues of non-residential property penetrate into

[9] Regional Survey, Vol. 8, pp. 160 and 163.

Long Island from Gowanus Bay and along Newtown Creek and into the Bronx along Westchester Creek and the Bronx River (Fig. 1). Narrow, broken strips of non-residential land, used for factories and tracks, mark the lines of railroads. Another type of non-residential property, represented by scattered patches in all parts of the city, is devoted to educational and charitable institutions. Many of these stand on elevations; for example, Columbia University, the College of the City of New York, and the Columbia-Presbyterian Medical Center on the ridge that dominates upper Manhattan, and New York University on a similar ridge in the Bronx. The largest continuous non-residential area in the city, the business "core" of lower Manhattan, will be discussed presently.

Residential Areas

The statistics brought together in Table I throw light on certain aspects of the housing situation in the city as a whole and in each of the five boroughs. It will be seen that in 1934 there were fewer families than family quarters (rows 3 and 11). At first glance this might seem to indicate that there was plenty of room for everybody. If, however, we look at row 12, we find that the number of occupied family quarters was smaller than the number of families in every borough, and row 13 shows that many of the family quarters were vacant. This implies a maladjustment of population to housing facilities. Undoubtedly the situation is partly due to the fact that many families, hit by the economic depression, are sharing apartments. The evil, however, particularly in Manhattan, is nothing new in the city's history. It existed during the boom times of the twenties and long before. Owners of many tenement houses have been financially unable to modernize them or else unwilling to do so in the expectation that the land on which they stand may soon be disposed of for business uses. "Furthermore, the indirect effect of the multiplication of skyscrapers on Manhattan has been to preserve untouched a quantity of obsolete business buildings in which industries that could not pay Manhattan rentals in modern structures are still persisting at the center of the Region. By so doing they help to keep many wage earners in the unregenerate old tenements and add others to the total number of people who commute to the heart of the city for the day's work."[10]

According to a survey made by the New York City Housing Authority in 1935, slums cover 17 square miles, or about one-eleventh of the total residential area of the city. The buildings on 10 of these square miles of slums (4.4 in Manhattan, 5.3 in Brooklyn) were considered "unfit for human habitation and economically unprofitable.

[10] Regional Survey, Vol. 2, Population, Land Values and Government, 1929, p. 63.

. . . In this vast area . . . there lived 516,360 families which paid monthly rentals as follows: Under $10.00 . . . 22,939 families; $10.00 to $19.99 . . . 183,683; $20.00 to $29.99 . . . 309,738."[11]

Some further evils of the housing situation are reflected in the following figures[12] for the whole city: 249,608 apartments without private indoor toilet, 309,157 without tub or shower, 322,065 without hot water, 39,429 in "fourth-class condition" (unfit for use). "During 1929, in Manhattan there were 1,139 fires among the 352,968 old-law apartments while there were only 393 fires among the 216,370 new-law apartments."[13]

The degree to which New Yorkers live either in tenements or apartments or in detached or semidetached houses is suggested in rows 7, 8, and 14. The Inventory's map of predominant residential types shows that Manhattan, the Bronx west of the Bronx River, and the older quarters of Brooklyn are characterized by multiple-family houses. Single-family houses prevail throughout Queens and Staten Island. In Manhattan there are only 542 two-family houses, about 1 per cent of all residential structures. In the other boroughs two-family houses are found especially in the intermediate areas between the inner zone of apartment houses and the zones farther out where most of the houses are built for the use of single families.

The figures and the map showing rentals, when examined in relation to other information compiled by the Inventory, enable one to divide the residential parts of the city into distinctive localities. Manhattan presents the most pronounced extremes in rentals: in that borough far more people than in the other boroughs live either in slums or in apartments of the most expensive type. By comparing rentals with types of residential structures (or, as in Figure 3, with densities of population) one may determine in a general way whether a particular locality is one of crowded tenements, of densely peopled but expensive apartment houses, of suburban slums, or of high-class detached houses. Outside Manhattan the areas where rentals are predominantly more than $60 a month for a family quarter are scattered and correspond to areas where most of the houses are of the single-family type.

How a neighborhood develops depends partly on the special interests and abilities of real-estate promoters and speculators in land. The rental map shows, however, that rentals, especially outside Manhattan, tend to be somewhat higher on ridges and hills than on flatter ground, though there are many exceptions to this generaliza-

[11] "First Houses," pamphlet published by New York City Housing Authority, 1935, p. 15.

[12] Data from the 1934 Real Property Inventory of New York City furnished by courtesy of the New York City Housing Authority.

[13] "First Houses," p. 12. "The 'old law' tenements are those that were erected prior to the passage of the Tenement House Law of 1901 and the creation of the Tenement House Department" (Regional Survey, Vol. 6, Buildings: Their Uses and the Spaces About Them, 1931, p. 236).

tion. Railroad tracks and yards, elevated railways, and industrial developments make the neighborhood of the main lines of transportation less attractive than the uplands, and people of means can afford to spend more time and money in getting to their places of work than

TABLE I—STATISTICAL DATA RELATING TO POPULATION AND RESIDENTIAL STRUCTURES IN NEW YORK CITY AND ITS BOROUGHS, 1934*

	NEW YORK CITY	MANHATTAN	THE BRONX	BROOKLYN	QUEENS	RICHMOND
1 Population	6,874,154	1,724,245	1,294,873	2,550,448	1,144,250	160,338
2 Day population	2,138,143	1,462,755	156,676	373,689	116,850	28,173
3 Families	1,889,574	501,099	355,113	675,758	317,582	40,022
4 Negro families, number	80,985	54,640	3,471	17,996	4,490	388
5 Negro families, per cent	4.3	10.9	1.0	2.7	1.4	1.0
6 Residential structures, number	594,437	56,498	58,862	246,897	196,904	35,276
7 Multiple-family structures, number	116,348	35,055	17,970	52,285	10,463	575
8 Multiple-family structures, per cent	19.6	61.7	30.5	21.2	5.3	1.6
9 35 years old or older, number	190,120	45,787	14,247	101,851	19,193	9,042
10 35 years old or older, per cent	31.7	81.2	24.2	41.3	9.7	25.6
11 Family quarters, number	2,067,065	590,767	376,637	713,928	341,033	44,700
12 Family quarters occupied, number	1,814,736	485,623	339,233	645,990	305,662	38,228
13 Family quarters vacant, per cent	12.3	17.8	10.0	9.5	10.4	14.5
14 Average number of family quarters to a residential structure	3.5	10.5	6.4	2.9	1.7	1.3

* Percentages in rows 5, 8, and 10 and averages in row 14 are computed from, and other data are copied from, Real Property Inventory, City of New York, Residential Reports, 1934.

people who pay low rents. The rental map shows a pattern of parallel belts in the Bronx that correspond to the "grain" of the relief, running somewhat east of north and west of south. The terminal moraine both in Long Island and in Staten Island may be detected on the map as a zone of somewhat higher rentals than those prevailing over much of the neighboring lower ground. Beyond the areas directly served by rapid-transit routes (the five-cent fare zone)[14] there are few large quarters where rentals fall in the lowest categories. Very poor people cannot afford to commute. In the outlying parts of the city low rentals prevail near the industrial areas, where laboring people live in cheap houses not far from their jobs.

[14] See map, Figure 20, in Regional Survey, Vol. 4, Transit and Transportation, 1928, p. 43.

Time Required To Reach Places of Work

In New York, as in every other great metropolis, most of the wage earners and business men and women have to travel considerable distances at a cost in time, money, and fatigue in order to reach the factories, stores, workshops, and offices where they labor during the day. This grave problem has been studied from many angles by city and regional planners and by students of traffic and transportation.

Table II—Time Required to Get to Work, Principal Income Earner, New York City and Its Boroughs, 1934*

Percentage distribution of reporting families

	New York City	Manhattan	The Bronx	Brooklyn	Queens	Richmond
0–20 minutes	22	31	15	20	19	18
20–40 minutes	35	49	28	38	27	32
40–60 minutes	19	15	27	24	20	17
60 minutes and over . .	24	5	30	18	24	33

*From Real Property Inventory, City of New York, Residential Reports, 1934.

As an aid to its analysis isochronic maps have been prepared showing the length of time required to reach the railroad terminals of Manhattan from different parts of the city and its surroundings.[15] A somewhat different type of investigation was made in connection with the Real Property Inventory. On the basis of house-to-house inquiries it was determined how many minutes daily the principal wage earner in each family devoted to reaching his work. Four time groups were differentiated, which, for convenience, may be called the A, B, C, and D groups, representing 0–20, 20–40, 40–60, and 60+ minutes respectively. For each census tract and borough the percentage of all reporting wage earners in each group is tabulated in the Residential Reports. The percentages for the whole city and each borough are shown in Table II. These data, of course, furnish no direct indication of where the workers actually go.

From the percentage figures the accompanying map (Fig. 2) was compiled. On it all areas having a density of population of 1 or more to the acre are classified A, B, C, or D, according to the time group showing the highest percentage in each census tract (thus the shadings may represent from 25 to 100 per cent of all reporting wage earners). The areas in which the A group predominates may be referred to as A areas, those in which the B group predominates as B areas, etc.

The A areas (0–20 minutes) form a large and fairly solid block of territory in Manhattan south of 59th Street. Elsewhere they are

[15] See, for example, the maps of New York and its environs showing railroad commuting time (Fig. 42) and railroad commuting rates (Fig. 40) in Regional Survey, Vol. 4, pp. 80 and 78 respectively.

scattered in small patches, many of which coincide with, or are adjacent to, zones of predominantly industrial use; for example, along the water fronts of the Upper Bay, East River, and Newtown Creek. From these areas the wage earners can walk to their work in near-by factories, docks, or warehouses. In the outlying parts of Queens some of the A and B (20–40 minutes) areas represent the older residential quarters of towns and villages that have been enveloped by the enlarging city but in which there are considerable communities of local businessmen and tradesfolk. In the sparsely settled outermost margins of the city where the density of population is less than 1 to the acre, most of the people belong in either the A or D group. Here the A group represents a population of market gardeners, of keepers of garages, filling stations, roadhouses, restaurants, and stores, and perhaps also, where rentals are high, of caretakers and other servants employed on large estates, cemeteries, etc.

Nearly all of Manhattan north of 59th Street, the southwestern Bronx, and the older part of Brooklyn north of and including the moraine are B areas (20–40 minutes). Tongues of B territory also project along rapid-transit routes southward toward Coney Island and eastward toward Jamaica. It is probable that most of the wage earners in the B areas of the Bronx and Long Island, where these areas are large and almost continuous, go by subway to work in Manhattan. This cannot be true, however, of the extensive but thinly peopled B regions in Staten Island, where a large proportion of the wage earners are probably employed in the industrial establishments of Elizabeth and Perth Amboy, N. J., and along the shores of Arthur Kill.

There are relatively few extensive C areas (40–60 minutes) in the remoter parts of the city. Most of the wage earners in those parts either commute to Manhattan, which takes more than an hour, or live within 40 minutes of their work. In Staten Island only 7 per cent of the wage earners are in the C group, whereas 33 per cent are in the D group. The ferry trip from Staten Island to Manhattan requires 25 minutes.

The edge of the area whose greater part falls in the D classification (60 minutes plus) is fairly well defined. Nearly all of the D region in Long Island lies within a zone from which passenger trains reach their destination in Manhattan in less than 30 minutes.[16] In the Bronx the railroad stations in the entire D region are within 45 minutes of Grand Central Terminal. This means that the average commuter from the D areas who uses the railroads must spend an aggregate of at least 30 minutes in Long Island and of at least 15 minutes in the Bronx in getting from his home to the local railroad station and from the terminal in New York to his place of work. It is possible that parts of the D area in the Bronx and northern Long Island would today

[16] Regional Survey, Vol. 4, Fig. 42, p. 80.

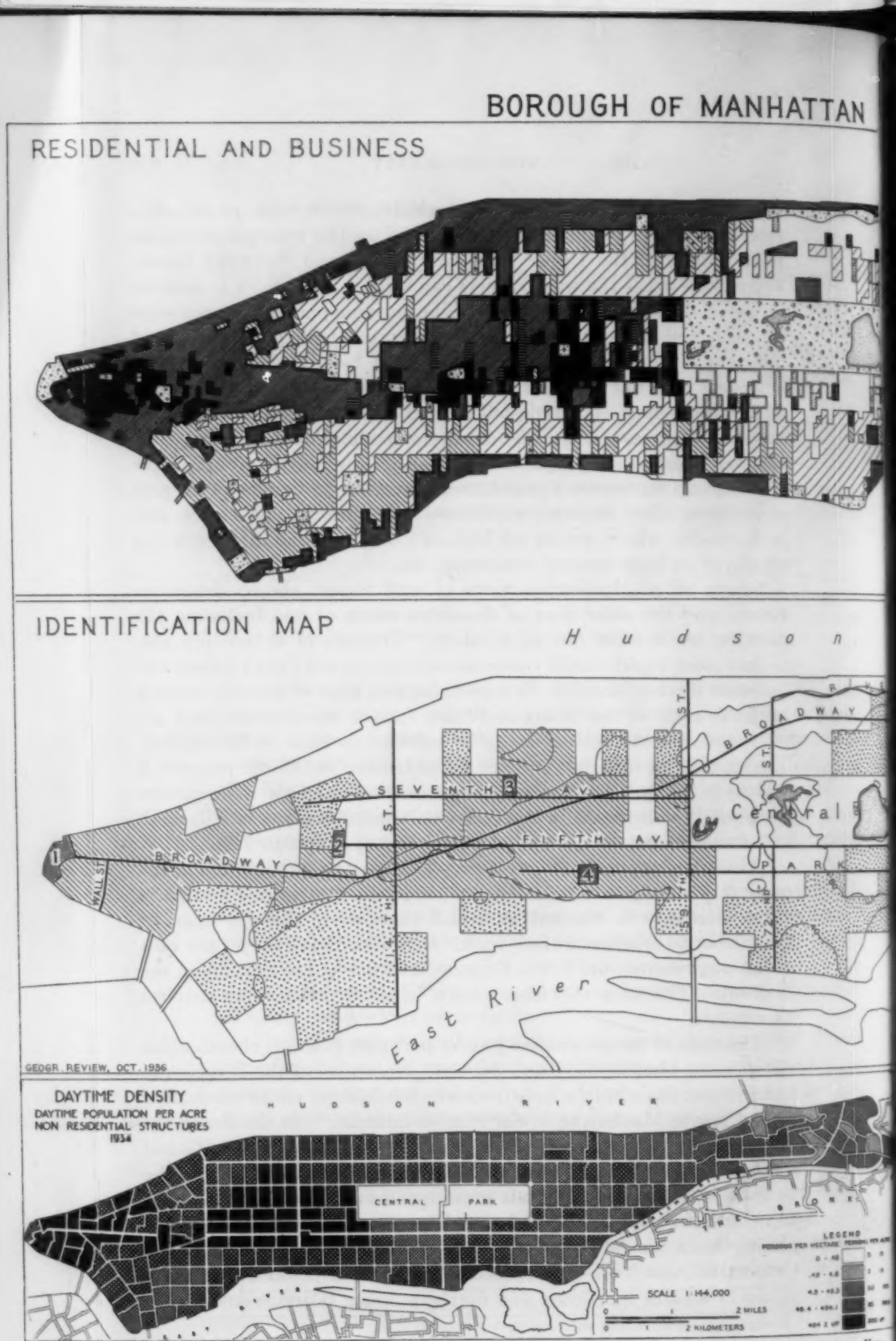
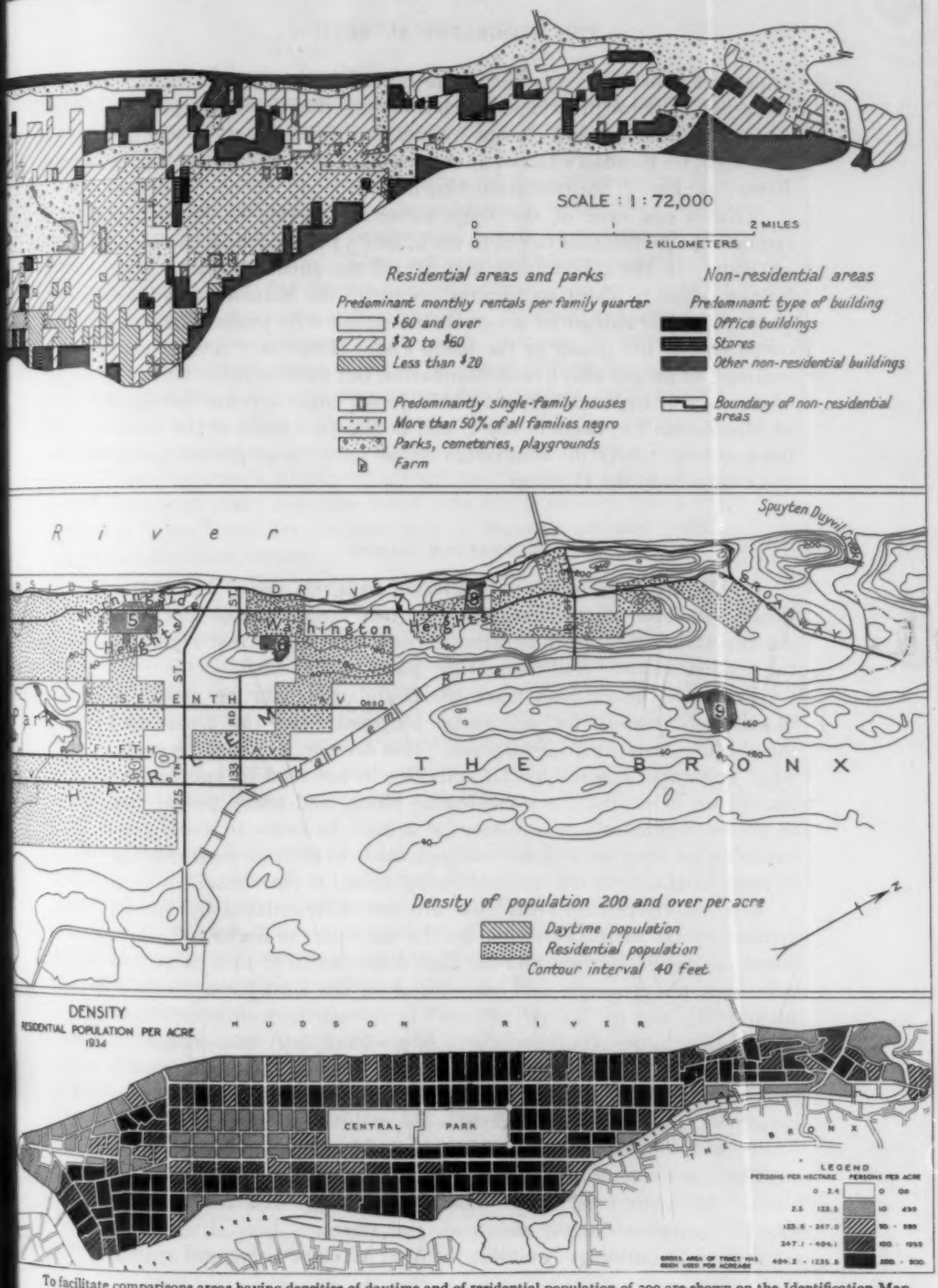


FIG. 3—Maps of the Borough of Manhattan, New York City, illustrating certain facts of land utilization and population, 1934. Key to numbers on Identification Map: 1, Battery Park; 2, New York University (part at Washington Square); 3, Pennsylvania Station; 4, Grand Central Terminal; 5, Columbia University; 6, College of the City of New York; 7, American Geographical Society; 8, Columbia-Presbyterian Medical Center; 9, New York University (part on University Heights).

NEW YORK CITY



To facilitate comparisons areas having densities of daytime and of residential population of 200 are shown on the Identification Map as well as on the two small population maps. The uppermost map was compiled mainly from the colored maps accompanying the Real Property Inventory, City of New York, 1934: the two small maps are reproduced directly from black and white maps in the Inventory's Residential Report on Manhattan.

bia-Presbyterian Medical Center; 9. New York University (part on University Heights).

appear as C areas, as a result of the completion on July 11, 1936, of the great Triborough Bridge, which links together the boroughs of the Bronx, Manhattan, and Queens by means of bridges and of viaducts that meet on Randall's Island at the southern entrance to the Harlem River (see Fig. 3, Identification Map).

Fifteen per cent of the wage earners reporting in Manhattan required 40–60 minutes to get to work, and 5 per cent took more than an hour. In the subway one may travel the entire length of Manhattan Island in about 50 minutes. Some of the Manhattan workers in the C and D categories are doubtless people who journey from the north end of the island to the south end. However, "reverse commuting" of people who live in Manhattan but work in other boroughs of the city or in Westchester or New Jersey must account for many of Manhattan's workers of the C and D classes. Some of the downtown census tracts in Manhattan show fairly large percentages of wage earners in the D group.

Manhattan Island

On the first map in Figure 3 selected data relating to Manhattan Island have been plotted from the Inventory's colored maps and other sources with a view to illustrating certain facts of interest regarding the residential and "non-residential" parts of the island.

The heavy black lines mark the boundary separating groups of blocks used mainly for residential purposes from the areas used mainly for non-residential purposes. This division, of course, is somewhat arbitrary; non-residential activities of one kind or another are carried on in nearly every residential block, and many people live in the predominantly non-residential areas. In order to avoid confusion on the map, no attempt has been made to indicate facts relating to residential uses in the non-residential areas, or vice versa.

The non-residential areas that are not differentiated by special symbols on the map are devoted for the most part to docks and warehouses along the Hudson and the East River south of 14th Street, to industries, powerhouses, and hospitals along the East River north of 14th Street, and to "loft structures" in the southern interior of the island. The largest continuous area of predominantly non-residential land in the city (other than vacant land and "permanent open spaces") forms a zone that extends from the Battery almost to Central Park. Broadway, underlain by subways, is the main artery of this business "core" of lower Manhattan (see Figure 3, Identification Map).

The non-residential buildings within the "core" are of four main kinds: "loft structures," office buildings, buildings used for "private special" purposes (largely theaters), and stores. "Loft structures" are defined as buildings "suitable for light manufacturing and rented

Real Property Inventory, City of New York, 1934; the two small maps are reproduced directly from black and white maps in the Inventory's Residential Report on Manhattan.

by floors or parts of floors" in which not more than 25 per cent of the building area is occupied by offices. Among the many uses made of the loft structures of Manhattan, clothing manufacture is the most important.

The map gives a clue to the distribution of the tall buildings in Manhattan, both residential and non-residential. The residential buildings, expensive apartment houses and hotels, in general range from 5 to 20 stories in height. They are confined almost entirely to the zones where residential rentals are the highest. Central Park is becoming more and more like a deep trench or "graben"—to borrow a physiographic term—between two "horsts" formed by masses of lofty structures. Most of the tallest skyscrapers of New York, however, are office buildings. As skyscrapers have sprung up in nearly all the blocks where office buildings predominate, the distribution of such blocks, as shown on the map, gives a fairly good idea of the location of these mammoth structures. They are clustered in four main groups, two large ones near the north and south ends of the non-residential "core" and two smaller ones in between, around Union Square and Madison Square.

The "core" of Manhattan is like a gigantic respiratory system that morning and evening inhales and exhales an immense "breath" of people. As in many of the other great cities of the world, the business and financial quarters of New York are almost deserted late at night and on Sundays and holidays. From the census reports one might gather that the "core" is one of the most sparsely populated parts of Manhattan. This is because, as Professor Jefferson has pointed out, censuses concern themselves with society asleep, though "society asleep is not society any more than a cemetery is a social community."[17]

New York is distinctive in that it has two principal business districts, or even three if a portion of Brooklyn is included. The centers of the two larger districts—Wall Street and 42nd Street—are separated from each other by a distance of a little more than three miles. Around both centers loom the mountainous masses of skyscrapers, but between them spreads a wide belt where quiet residential streets may be found. Indeed, in the neighborhood of 14th Street the business "core" is so narrow that the residential East Side nearly meets the residential West Side. Until 35 years ago there were no towering office buildings north of this narrow area, and much of what is now the mid-town business section was still used for dwellings. The completion of the Grand Central Terminal and the Pennsylvania Station and of rapid-transit lines giving ready access to outlying parts of the city and its surrounding region was followed by an as-

[17] Mark Jefferson: Distribution of the World's City Folks: A Study in Comparative Civilization, *Geogr. Rev.*, Vol. 21, 1931, pp. 446–465; reference on p. 458.

tonishingly rapid development of business uses. Especially since the World War mid-town Manhattan has undergone a radical alteration. Most of the towers that now punctuate its sky line will stand as monuments to the economic boom of the nineteen twenties. During the four years 1925–1928 inclusive no less than 76 buildings of 21 stories or more in height were erected in Manhattan as compared with only 41 such buildings constructed during the preceding 12 years, 1913–1924.[18]

Forty-nine census tracts in Manhattan had in 1934 a density of "daytime population" of more than 200 to the acre (128,000 to the square mile). All these tracts lie south of 59th Street; the outer limit of the area they occupy (Fig. 3) corresponds approximately to the boundaries of the non-residential "core" of Manhattan. The residential population of this non-residential area (about 113,000) would in itself make a medium-sized city. The daytime population, however, which is defined as including those "who work . . . regularly [in the area], regardless of where they live," was nearly ten times as large in 1934: 1,128,464 (439,299 south of 14th Street and 689,165 north of it). In order to obtain an adequate idea of the magnitude of the "breath" of people inhaled and exhaled daily by Manhattan's business centers, there should be added to the daytime population of the Inventory a figure representing nonperiodic visitors—shoppers, students, theatergoers, and the like. Such a figure is probably between 500,000 and 1,000,000.[19]

According to the Inventory the greatest daytime density of regular workers was recorded in Census Tract No. 7, in the downtown financial section, an area of 43 acres lying between Broadway and the East River and including Wall Street. In this tract the residential population was 76; the daytime population was 116,845, or about one person to every 20 square feet of ground surface. The dangers inherent in such crowding in the event of a calamity or panic hardly need be enlarged upon. The second-largest daytime population was that of Census Tract No. 109, in the mid-town section, an area, also of 43 acres, bounded by Sixth and Seventh Avenues and 34th and 38th Streets. This tract contains one of the city's largest retail stores and also 104 loft structures devoted mainly to clothing manufacture. It

[18] Regional Survey, Vol. 6, p. 59. See also map (Fig. 31) showing heights of buildings south of 59th Street, *ibid.*, opposite p. 60.

[19] According to an estimate made by the Regional Plan of New York (Regional Survey, Vol. 3, Highway Traffic, 1927, p. 62) the total daytime population of Manhattan south of 59th Street on a typical business day in 1924 was 2,941,700. This figure includes not only those who worked regularly in the area but also residents and visitors. The number of residents was reckoned at 940,000. Subtracting 940,000 from 2,941,700 gives a total of about 2,000,000 for the non-residential daytime population of Manhattan south of 59th Street in 1924. It may be presumed that by far the greater part of this population was concentrated in the non-residential "core." It numbered about 900,000 more than the 1934 daytime population of the "core" according to the Inventory. That 1934 was a depression year when fewer regular workers were employed than in 1924 may account for part of the difference, but most of the difference is probably to be ascribed to the fact that the Inventory figure does not include nonperiodic visitors.

had in 1934 a daytime population of 59,663 and a residential population of 260.

Business has not made so complete a conquest of residential uses in mid-town as in downtown Manhattan. No mid-town census tract had a residential population of less than 100 persons; downtown there were 6 tracts with less than 100. Only 19 persons resided in the area bounded by Broadway, West Broadway, Park Row, and Canal, Reade, Vesey, Pearl, and Center Streets, though 54,328 persons worked there during the day. As the density of the residential population in this area was less than 1 person to the acre, its three census tracts have been left blank on the lower right-hand map of Figure 3.

The only other part of the city where there is a notable accumulation of office buildings is near the Borough Hall in Brooklyn. This, however, hardly bears comparison with the office centers of Manhattan. In Brooklyn the daytime population was more than 200 to the acre in only four census tracts, as compared with 49 tracts in Manhattan. The four tracts in Brooklyn had a total daytime population of 51,932, or only about one-twentieth of that of the corresponding tracts in Manhattan.

The uppermost map (Fig. 3) shows that business has not entirely obliterated what was once the most fashionable residential quarter of the city—the belt on both sides of Fifth Avenue between Central Park and Washington Square. Remnants of this belt appear as patches of high-rental territory along the east and southwest edges of the business "core." The map makes clear the manner in which Central Park and Riverside Drive have attracted high-class residential development in the adjacent blocks. The narrow East River, with its polluted waters[20] and its factories on the Long Island side, has failed to exert so powerful an attraction, though at several points fashionable apartments have appeared along and near its shores. The only part of Manhattan where any large number of property owners can afford to maintain single-family residences is in the Park Avenue and Fifth Avenue sections east of the southern part of Central Park.

The proximity of slums and palatial apartment houses, a striking feature of Manhattan's human geography, is suggested by the distribution of rentals as shown on the map. Third Avenue, with its elevated railway, separates the East Side zones of wealth and of poverty. On the West Side, instead of two longitudinal zones, there is a sharp dividing line at 72nd Street. South of this line the land slopes gently down to the Hudson, and the cross streets reach the water front at grade. Docks in unbroken succession line the river from 72nd Street south. Behind the docks residential rentals are low, and a poorer quarter extends to the edge of the non-residential "core" of the island (except in and about Greenwich Village). From 72nd

[20] See Regional Survey, Vol. 8, p. 59.

Street north a ridge borders the river. The steep west slope of this ridge has been made into a park along Riverside Drive, and few of the cross streets come down to the water front. Only where a valley cuts through the ridge at 125th Street is there a break in the continuity of the high-class residential fringe along the Hudson.

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THE GEOGRAPHY OF NORTH AMERICA: A HISTORY OF ITS REGIONAL EXPOSITION

W. L. G. Joerg

THE appearance of Baulig's "North America," which has just been published,[1] is an event of outstanding importance to American geography. In this work the French school of geography has applied itself to the continent that interests us most. The result is a work that represents the full fruition of the regional method of modern geography.

As regards other continents and major areas of the world this method has already borne choice fruit, as is attested by the other volumes in the series of which this work forms a part and by the number of excellent syntheses that have been produced by professional geographers since the beginning of the modern development of their subject about fifty or sixty years ago. Even as regards North America that development has yielded, as will presently appear, seven or eight works in four languages (three of them within the last three years) that meet the standards of modern regional exposition. But among these, by the amplitude of its canvas, the completeness and balance of its treatment, the penetration of the source material, and the quality and integrat on of its illustrations, Baulig's work stands supreme.

History of Regional Geographies of North America, 1877-1934

To evaluate the significance of this work properly and to gain perspective, it seems desirable to survey the history of regional exposition as applied to North America as a whole, or to the United States or Canada separately,[2] since the development of modern geography (Table I, p. 659). This may in itself not be without interest, in view of the scattered nature of the publications and the diversity of their origin, as to both the concepts that brought them into being and the languages in which they are written. The inclusion of a work in the table does not necessarily mean, especially for the earlier years, that it is a regional geography in the modern sense of the word, but every work included is thought to have had, in the national group from which it emanated, some significance in the development of the methods of regional exposition.[3] Completeness is, of course, not claimed for the table. As to the present survey, in general it should

[1] Henri Baulig: Amérique septentrionale (Géographie Universelle, publiée sous la direction de P. Vidal de la Blache et L. Gallois, Vol. 13), 2 vols. (Part 1, pp. 1–315; Part 2, pp. 317–639). Librairie Armand Colin, Paris, 1935–1936.

[2] It is not the intention in the present survey to consider units subordinate to these in size, though expositions of such units of course exist and are of importance in the methodology of regional geography. On the relation of methods of exposition to size of area see below, pp. 644 and 651.

[3] Works of this kind, which may, for example, deal with only one element of regional geography, or which may be anthologies only, are enclosed in brackets in the table.

be borne in mind that the regional treatment of North America as a rule forms only a part, often only an incidental or peripheral part, of the regional movement in each country concerned. The real mainsprings of regional methodology and its guiding concepts have been centered elsewhere, usually, of course, in the geography of Europe.

Modern Geography and the Universities

Modern geography may be said to date essentially from the establishment of the subject in the universities. In the four countries of Europe that have been the leaders in this development these dates are approximately as follows: Germany, early 1870's; Italy, late 1870's and early 1890's; France, about 1890; Great Britain, late 1890's. In Germany the subject was accorded university status at all Prussian universities in 1874, but at these, as at other German universities, some time elapsed before it was fully under way, owing to the lack of qualified teachers (Richthofen's directive inaugural address at Leipzig is of 1883). Influenced by the German example, modern geography in Italy had an early start. Dalla Vedova's incumbency of the chair at the University of Rome dates from 1875 and Giovanni Marinelli's of the chair at Padua from 1879. However, it was not until about a decade and a half later—the *Rivista Geografica Italiana* was founded in 1893—that the movement proceeded on a broad front. In France in about 1890 the pupils of Vidal de la Blache at the École Normale Supérieure were on the threshold of their own careers, and the *Annales de Géographie*, the organ of the university group, began publication in 1891. In Great Britain, as a result of the Royal Geographical Society's investigation of the status of geography in Europe by Keltie in 1884–1885, Mackinder's readership at Oxford was established in 1887, but it was not until about ten years later that the full effect of the reform movement made itself felt: the School of Geography at Oxford was created in 1899 (Herbertson's appointment as assistant to the Reader dated from that year), and Mackinder's "Britain and the British Seas" appeared in 1902.

In Scandinavia university recognition of geography came rather late, though the subject itself had long been in a high state of development in the whole territory of Scandinavian culture and influence, including Finland. At Swedish universities the modern aspect of the subject may be said to date from about 1910, though there were earlier facets oriented from history and commercial geography; and Otto Nordenskjöld's transition from the professorship of geology and mineralogy at Upsala to that of geography at Gothenburg took place in 1905. In Denmark the date is about 1915, by which time Steensby was progressing fully toward geography from his original interest, ethnography, after having been appointed to the chair of geography

at the University of Copenhagen in 1911. The work of his forerunner in that chair since 1883, Ernst Løffler (which was most active at the beginning of his incumbency, an activity that is reflected in Table I), may be said to represent, as did the similar situation in Italy, a response to the early development of geography in Germany.

In our own development in the United States the growth from physical geography, with its special emphasis on physiography, into the fuller conception of the subject to include and stress human geography may be said to have led to two periods of inception in the establishment of the subject as a university discipline.[4] The first falls in the late 1880's and the second in the early and mid-1900's. By the former date the work of Professor Shaler of Harvard had reached the geographical orientation indicated by the publications listed in Table I and discussed later (p. 647), and Professor W. M. Davis, who had been appointed in 1878 instructor in geology as Shaler's assistant, had by 1889 developed the theory of the erosional cycle, from whose development and diffusion the period of modern geography in the United States may be reckoned.[5] The year 1891 provides a cross section that, as has been pointed out,[6] discloses as students of Shaler and Davis six of the men who were to shape the development of geography in the United States in the next decades. The first orientation toward human geography in the early 1900's came through economic geography and centered in the school of commerce at the University of Pennsylvania. Creation of a separate department of geography at the University of Chicago in 1902–1903 ensured the cultivation of the human aspects of geography. Harlan H. Barrows' course on the historical geography of the United States dates from 1904, and in 1906 Ellen C. Semple began her association with the department as visiting lecturer on anthropogeography. In 1906, at Yale, Bowman gave lectures on the regional geography of South America to summer-school students, and in the academic year 1906–1907 he offered a course in the geography of North and South America, which was divided the next year into two separate courses, one for each continent. In 1909 a course in anthropogeography was given there jointly by Bowman and Ellsworth Huntington.

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[4] As the early history is less familiar and accessible to geographers abroad (it is briefly touched on, with gaps, in G. G. Dept: L'étude et l'enseignement de la géographie aux Etats-Unis, *Bull. Soc. Royale Belge de Géogr.*, Vol. 50, 1926, pp. 119–132), the following references are offered mainly for the guidance of foreign colleagues: C. C. Colby: Changing Currents of Geographic Thought in America, *Annals Assn. of Amer. Geogrs.*, Vol. 26, 1936, pp. 1–37; W. M. Davis: The Progress of Geography in the United States, *ibid.*, Vol. 14, 1924, pp. 158–215; W. M. Davis: A Retrospect of Geography, *ibid.*, Vol. 22, 1932, pp. 211–230; W. M. Davis and R. A. Daly: Geology and Geography, 1858–1928, *in* The Development of Harvard University, edited by S. E. Morison, Cambridge, Mass., 1930, pp. 307–328; A. P. Brigham: William Morris Davis, *Geographen-Kalender*, Vol. 7, Gotha, 1909, pp. 1–73; "The Autobiography of Nathaniel Southgate Shaler," Boston and New York, 1909.

[5] The papers on the Triassic of the Connecticut Valley and on the rivers and valleys of northern New Jersey and Pennsylvania bear the dates 1889 and 1890. The doctrine was made available to the educational world in 1898 in the high-school text "Physical Geography."

[6] *Annals Assn. of Amer. Geogrs.*, Vol. 20, 1930, p. 56, and Vol. 26, 1936, p. 17.

The history of university geography in Canada is brief. Whatever work was done in this field came either from historians (George M. Wrong at the University of Toronto since about 1895) or from economists and sociologists (H. A. Innis at Toronto, C. A. Dawson at McGill, and W. A. Mackintosh at Queen's, since about 1925). Full recognition of the subject has come only in 1935, with the establishment of the first chair of geography in Canada, at the University of Toronto, to which Professor Griffith Taylor was appointed.[7]

Separate Development of Regional Geography in Different Countries

The arrangement of the table by nationalities,[8] in addition to its obviously called-for chronological arrangement, is justified by the fact that, on the whole, the development of regional geography as part of modern geography[9] took place independently in the various countries and that the time of its incidence in each case was a result rather of the stage of internal development of the subject than of external influences. To be sure, the example of Germany in the 1890's is traceable in the concept originating Marinelli's "La Terra," the 8-volume regional geography of the world published between 1883 and 1901 (of which Porena's "North America" forms a part); and there is an early episode, of no developmental consequence, of American contact with German geography in the fact that the first treatment (1883) of North America in Stanford's "Compendium of Geography and Travel" is a translation of the corresponding part of Von Hellwald's "Die Erde und ihre Völker," the United States section being adapted by F. V. Hayden, former head of the U. S. Geological and Geographical Survey of the Territories. But such instances as these are the exception, and on the whole each country's growth was indigenous. Even the English-speaking countries did not exert much influence on one another. The early Canadian and American works, dealing primarily with the physical geography of Canada and the United States respectively, emanated from geological circles and had little subsequent influence on regional geography except as a source of information. Mill's "International Geography" (1899) was to become the first common meeting ground of contributors from all parts of the English-speaking world, as indeed of geographers from everywhere.

[7] *Canadian Geogr. Journ.*, Vol. 11, 1935, pp. iv (Nov.) and 214–216.

[8] The Italian works omitted from the table itself for lack of space are referred to at the bottom of the table and cited by title in the list that follows it. As to range of nationalities, the table, even with this addition, is not necessarily complete; it does contain, however, the leading countries in which regional geographies of North America have been produced.

[9] The phrase "regional geography of" preceding the name of a given area or country is used in this survey to designate a geography of an area written according to modern methods. The slight redundancy involved is deemed permissible to gain this precision. On the other hand, the phrase is here meant to carry no implication as to the organization of region l exposition, and specifically it is not meant to designate exclusively expositions organized by regional subdivisions.

That the lists differ markedly in length is not surprising in view of the varying length of time that modern geography has been established in the several countries and the somewhat unequal state of development that it has attained. The number of professionally trained workers resulting from these two factors, many in some countries, few in others, affects the range of regional discussion that they are likely to undertake. Where there are many, there are probably always some who specialize in a given continent or major area. This obvious reflection has special significance where the regional geography of North America is concerned. For, with the possible exception of Australia, no continent has until very recently less engaged the attention of Continental European geographers than North America. Europe, of course, is the homeland; with Asia and Africa there are ties of historical association and colonial interests; and South America still provides a field for scientific exploration both because of unsolved problems and because of a dearth of native investigators. But North America, the home of a modern industrial civilization whose bearing on the affairs of Europe is only of recent realization, could be left to its own scholars. It is with some such considerations as these in mind that many of the Continental discussions of North America up to eight or ten years ago may, not unfairly, be judged. There are a number of notable exceptions, but in the main these discussions owe their existence to the praiseworthy desire to provide a complete survey of the world. In such a scheme it is inevitable that the areas farthest from the center of interest should fare less favorably.

Length of Regional Exposition As Factor of Adequacy

Such world surveys are usually contained in one or two-volume handbooks by a single author or a group of authors or in a series of volumes in which each continent, generally by a different author, is represented by a separate volume. Manifestly, length is an important factor governing the adequacy of a regional discussion. As with the scale of a map, so in regional description, it is not possible below a certain limit to bring out all the essentials in the portrayal of an area. Because of the importance of this factor in the proper appraisal of a given regional geography, the number of words (in thousands) in the works listed in Table I is indicated in that table. The examination of the works discussed in the present inquiry would seem to show that about the following number of words is needed to deal adequately (from the standpoint of the regional geography of continents) with the areas named: North America as a whole, 90,000–100,000 words; the United States and Canada separately (if preceded by a continental synopsis), 175,000–200,000 and 50,000–60,000 words respectively.

German, French, and Italian Handbooks and Regional Series

Of the accounts in the handbooks that by Hettner is a model of concise regional treatment in which the mastery of the background material produces sureness of touch in the selection of essentials and precision in their generalized presentation. The tectonic maps are especially illuminating. The volume of the "Grundzüge der Länderkunde" of which this account forms a part was not published until 1924, though the volume on Europe had appeared in 1907 and Hettner's text to Spamer's atlas, from which the work derives its origin, about 1897. Of high scientific merit also is Lautensach's treatment (1920) that forms part of a handbook of general and regional geography accompanying Stieler's atlas. The sections on North America, Canada, and the United States in Gerbing's handbook (1927), in method, content, and orientation, are not among the most felicitous in this manual. The accounts by Kergomard and De Lamothe (1914) and by Granger (1922) are contained in two French series that, physically, resemble the "parlor albums" of our own Victorian age. They illustrate, however, as do a number of German accounts, how the high state of development of a subject in a given country makes available a professionally trained authorship even for secondary works. Somewhat similar undertakings, but of more modern orientation, are the German series containing Dietrich's account (1933) and the Italian series containing Errera's (1934). The former benefits from the author's travel and study in the continent he describes, though the work is not devoid of occasional lapses into banality and superficiality. The Italian series, in 8 volumes, is edited by one of the leading geographers of Italy, but the volume on North America unfortunately adheres to a discussion of general aspects and does not advance to a real geographical exposition by regions, nor are the photographs always critically chosen or adequately explained. Treatment by regional subdivision is also lacking in the volume by Michieli (1935) on North America as a whole and Canada; the volume affording amplest scope for such treatment, that on the United States, has not yet appeared in this other Italian series, which is published by the same house as "La Terra" of thirty-five to fifty years ago. On the whole the American reader of these recent Italian accounts misses the touch of field experience that a Calciati or an Olinto Marinelli would have been able to impart.

Among earlier regional series that edited by Sievers and begun in 1893–1895 was outstanding. North America was in the hands of Deckert, a pupil of Peschel. This volume never changed much from the conventional description of the older school and was rather uninspired. Between the second and third editions Sievers published an abridged edition in two volumes in which the entire material was rewritten and reorganized by him on a natural-regions basis (with

regional maps). A fourth, condensed edition of this volume on North America, based on the third edition, was published after Deckert's death by Machatschek in 1924. This, in spite of improvement, breathes the same atmosphere, whereas, working under a different plan, the same author has produced (1928) an admirable geography of North America as a unit, critically documented by source material.

English Accounts and the Influence of Educational Geography

Among British publications the relevant sections in Herbertson's "Handbook of Geography" (1912) are still among the best in the few handbooks written in English by a single author. The considerably shorter treatment in Miss Newbigin's "New Regional Geography of the World" (1929) is also of interest. Such books as these verge closely on school textbooks, a category purposely omitted from the present survey, which aims to deal with the scientific aspect of regional exposition. However, the fact that in Great Britain the rise of modern geography has been closely associated with the school world and that in the secondary system the teaching of the subject reaches into the upper classes has led to the production of textbooks of a relatively high grade and advanced level of information—much more so than in the United States, where the subject in the schools is limited to the elementary and intermediate grades.[10] As a result, especially in further consequence of the greater understanding due to common language and institutions, a British school text on North America may provide a more adequate and accurate representation than an account in a Continental handbook. With Jones and Bryan's "North America" (1924), however, we come to a work of scientific caliber—indeed the first regional geography of the continent in English written by professional geographers from the point of view of modern geography. Although not uniform in its treatment, either topically or regionally, it marked the beginning of a new era in the history of the regional description of North America.

Canadian and American Contributions

The history of Canadian and American accounts is of special interest to us. As pointed out above, the early descriptions, in keeping

[10] Ordinarily it is only at these levels that regional geography is dealt with in American education, high-school and college geography, to the extent that they occur, being concerned with general principles, and, if concerned with regional elements such as the land-type belts of the world, then mainly to illustrate these principles. An exception to this is C. R. Dryer's "High School Geography: Physical, Economic, and Regional" (New York, 1911), in which the world is discussed by natural regions. R. S. Tarr and F. M. McMurry's "North America" (New York, 1900) was a text intended for elementary classes, though its rather detailed content led to its being used by some foreign authors of geographies of North America as a source book. (On these and other American school texts see A. P. Brigham and R. E. Dodge: Nineteenth Century Textbooks of Geography, *in* The Teaching of Geography, *32nd Yearbook Natl. Soc. for the Study of Education*, Bloomington, Ill., 1933, pp. 3–27, and C. R. Dryer: A Century of Geographic Education in the United States, *Annals Assn. of Amer. Geogrs.*, Vol. 14, 1924, pp. 117–149.)

with the development of the times, issued from geologists and dealt mainly with physical geography. But in each country, Canada and the United States, there was a man of broad vision who could not be confined narrowly to one aspect only when reality had so many facets. George M. Dawson, later director of the Geological Survey of Canada, starting with a physical description of western Canada (in his joint account with A. R. C. Selwyn, 1884) expanded this into a physical geography of the whole country in 1897 in the "Handbook of Canada" issued for the British Association meeting in Toronto and into a complete geography of the country in a publication first issued in 1892 and revised in 1904. In the United States, Shaler, social philosopher as well as geologist, in 1884 supplied the introductory chapter, on the physical geography of North America, to Volume 4 of Winsor's "Narrative and Critical History of America." The second, longer part of that chapter is characteristically entitled "Effect of the Physiography of North America on Men of European Origin." The same theme was amplified into a geography of the continent in his "Nature and Man in America" (1891) and "The Story of Our Continent" (1892), which latter, although "for the use of schools," he correctly states in the Preface "departs widely from the ordinary text-books which give an account of North America." The fullest treatment is given in the work entitled "The United States of America" (1894), produced by Shaler and numerous other contributors under his editorship. It deals with the physical setting and the economic and social activities of the American people. There are regional chapters on the East and South and on the West by Shaler himself, and his "Summing Up of the Story" provides a valuable corrective to some of the accounts of social conditions by the Continental geographers.

Contemporaneous with Shaler's works is J. D. Whitney's "United States" (1889), in some respects the first adequate geography of the country by an American in the period under discussion. This book by the former state geologist of California was originally prepared for the ninth edition of the Encyclopædia Britannica. A later (1894), somewhat amorphous supplement deals with population, immigration, and irrigation. Gannett's volume (1898) in Stanford's "Compendium" contains much good geographical material, but it does not rise to the level of a regional geography. The volume of papers by different authors on the physiography of the United States published in 1896 is of high significance in the record because a number of these papers represent the first attempt to portray the physiography of a region as compared with the previous practice of dealing with regional cases merely as examples to illustrate physiographic processes. In it, too, the need for a general orientation and regional classification is squarely met in J. W. Powell's paper and map of the physiographic provinces of the country.

Molded by the set plan of the book, W. M. Davis' chapters on North America and the United States in Mill's "International Geography" (1899) transformed general physiography into geographical material by its organization around the regional principle. In complete contrast is I. C. Russell's "North America" (1904), in which different aspects of the geography of the continent as a whole are treated separately, practically without relation to one another; and yet this volume, as an invited contribution to Mackinder's regional series, had the opportunity of being the American counterpart of that editor's classic "Britain and the British Seas." Regional physiography came fully into its own with the publication of Bowman's "Forest Physiography" (1911), in which the great body of relevant geological literature, and especially that of the U. S. Geological Survey, was summarized and set forth regionally. It contains (pp. 108–110) the first adequate statement of the regional principle in an American work on physiography. Fourteen years later appeared the first modern regional geography of North America by an American, J. Russell Smith's "North America" (1925). Here was an account organized sufficiently minutely by regions and of sufficient length to deal adequately with all the essentials—an account benefiting from that intimacy with one's own country and its problems that is only with rare exceptions vouchsafed to the foreigner—and written in an interesting and direct manner, often with brilliance. From the standpoint of historical continuity it is interesting to note that Smith acknowledges his indebtedness to the work of Shaler, "my unseen master." A briefer work of similar trend to Smith's is Miller and Parkins' "North America" (1928), though here the regional units tend to be grouped around the dominant economy of a major section.

Reclus and Ratzel

Before passing to a consideration of the very latest books of the modern school, it will be of interest to dwell for a moment on three works from the beginning of the period that arouse expectations because of their major proportions and because, unlike most others at the time, they were written by professional geographers. These are Reclus's "Canada" (1890) and "United States" (1892) and Ratzel's "United States" (1878–1880 and 1893).

Reclus's two volumes form part of the regional geography of the world in 19 volumes that he produced singlehanded in eighteen years (1876–1894). As in the case of most of Europe, North Africa, and parts of South America, his qualifications included personal familiarity with the people and countries he was describing. Having been forced to leave his native France as a result of the *coup d'état* of Napoleon III, he spent more than three years of his young-manhood (1853–

1856) as a tutor in the family on the Fortier plantation near New Orleans. During this sojourn he made a trip up the Mississippi and may have gone as far as Chicago and Niagara Falls.[11] In late middle age, as part of a number of trips made to collect source material, establish contacts, and gain firsthand impressions for the series, he again crossed the Atlantic and in 1889 visited the Middle Atlantic States, New England, and parts of Ontario and Quebec. On the whole, the resulting account of Canada is better than that of the United States, because its organization by six or seven regions affords a realistic framework. In the volume on the United States, on the other hand, the country is divided into only three areas, the Appalachians and the Atlantic slope, the Great Lakes and the Mississippi-Missouri Basins, and the Cordillera and the Pacific slope—large units for so lengthy a book (265,000 words). An attempt to refine the regional characterization of this coarse division is made by following the discussion of each of the three areas by descriptions of the states, one by one, that compose it. The result is barren and encyclopedic. The physical description of the three areas, with its emphasis on river basins and its wholly ungenetic treatment of surface features, distinctly belongs to the old order. On the other hand, there are forward-looking passages, like that dealing with the potentialities of agriculture in the Canadian North, and discerning portrayals, like that of the French Canadians, that make occasional reference to these North American volumes still of interest. The usefulness of the numerous text maps by Charles Perron, illustrating both broad relationships and the detail of critical areas, was attested by the extent to which they were reproduced in Shaler's "United States" (1894). The drawings, numbering in the hundreds, of Perron's text maps for the whole 19 volumes and the source maps used in their preparation were at last reports (1931) in the Cartographic Museum of the University of Geneva, Switzerland.

Ratzel's "United States" is in two volumes, one dealing with the physical, the other with the human, geography of the country. Ratzel was not one of those to whom the United States was merely of marginal interest. Writing in 1878, he deplored the lack of a geography of the country, British, American, French, or German, embodying the advance of knowledge in the last twenty-five years. In German the last comprehensive work had appeared in 1854.[12] And yet, he says, as to physical geography, fully four-fifths of the data on which its principles are based are derived from Europe and North America.

[11] Based on Max Nettlau: Élisée Reclus, Berlin, 1928, pp. 57–69. This interpretation of the itinerary seems more plausible than the one given in Guillaume de Greef: Éloges d'Élisée Reclus et de De Kellès-Krauz: Discours prononcé . . . [à] l'Université Nouvelle de Bruxelles . . . 3 novembre 1905, Ghent, 1906. Both publications contain interesting details on the composition of the 19-volume series (Nettlau, pp. 179–184; De Greef, pp. 25–27 and 30–33).

[12] Karl Andree: Nord-Amerika in geographischen und geschichtlichen Umrissen, with atlas of 18 maps by Henry Lange, 2nd edit., Brunswick, 1854.

And on the human side, you must know the United States if you wish to understand the modern world. "Indeed, it may even be asserted that the political insight of a people is directly proportionate to its degree of understanding of what is taking place today in North America and what will take place there in the future." His conviction was based on personal knowledge. Soon after receiving his doctor's degree at Heidelberg in 1868 he served as correspondent to the *Cologne Gazette* (*Kölnische Zeitung*) and in this capacity traveled widely throughout the world. The years 1873–1875 were spent in the United States. The first volume deals with the different aspects of the physical geography of the country as a whole and intentionally avoids any regional division in this part "in order not to interrupt the continuity of the exposition of each physical element." Regional treatment is represented at the end of the volume by a series of short, impressionistic sketches of various areas or aspects of nature throughout the country. It is interesting to note a similar treatment in the latest Swedish geography of North America (Nelson, 1926). In Ratzel, as in Reclus, the description of relief is almost wholly topographical. But it is the second volume, and especially its second edition of 1893, that constitutes a distinctive contribution that is still of value and interest. Under its subtitle of "Political Geography" it deals with such matters as size, space, and boundary relationships, national stocks and race problems,[13] population distribution and growth, immigration, internal migration, agriculture, forest and mineral resources, trade, transportation, commerce on land and sea, administrative systems, educational and spiritual life, social conditions. There is a concluding section on the *Kulturlandschaft* of the United States, accompanied by a general land-use map of the country in 1 : 10,000,000. The author's personal knowledge and catholic viewpoint pervade the discussion of economic, social, and political conditions and maintain this as one of the best-balanced discussions of these questions in geographical literature by a foreigner. Hence this volume is still of value as a cross section of the economic and human geography of the country more than sixty years ago by a trained observer and as the work in which a number of methodological concepts were introduced that are still being shaped and molded in modern geography.

Organization of Subject Matter in the Seven Leading Works, 1924–1934

In this rapid survey, mainly by nationalities, of the regional geographies of North America that have been published in the last fifty to sixty years it has necessarily been impossible to touch on all the

[13] In the preface to the 1893 edition of the second volume Ratzel acknowledges his indebtedness to Miss Semple for help in clarifying certain aspects of the negro question. During the preceding year she had been his student at Leipzig (C. C. Colby: Ellen Churchill Semple, *Annals Assn. of Amer. Geogrs.*, Vol. 23, 1933, pp. 229–240; reference on p. 231).

works listed in Table I, since the main aim has been to outline trends of thought and this has consequently involved difference in emphasis.

Of the works listed in the table, exclusive of Baulig's there are seven outstanding ones from the point of view of modern geography. They differ in treatment, as some of them do in the purpose for which they are intended, but they are all regional expositions that meet the requirements of modern standards. It is worth while noting that all the foreign geographers in this group have made study trips to the continent they describe, and several have resided there for a time. In the order of the table the seven works are: Machatschek (1928), Schmieder, Blanchard, Jones and Bryan, Smith, Miller and Parkins, Nelson (1926). Before turning to a closer consideration of Baulig's work it may be of interest briefly to study the organization of their subject matter. In so doing it will be possible to characterize also the first three works, of which only Machatschek has hitherto been mentioned.

Broadly, three types of organization are represented: treatment of the continent as a whole; treatment of the continent as a whole, followed by discussion of its regional subdivisions; treatment by regional subdivisions. Machatschek follows the first method; Schmieder, Blanchard, Miller and Parkins, and Nelson follow the second; and Smith follows the third. The plan of the book by Jones and Bryan is somewhat different, but it tends toward the third type.

Machatschek's book is primarily a text for graduate students of geography and forms one of the regional volumes of a work of which the section on general geography is Hermann Wagner's well known "Lehrbuch der Geographie." For the scale on which the regional volumes are projected treatment by subdivisions is considered too detailed, and regional discussion is by continents alone (except for a brief chapter at the end in which a synopsis of the major natural regions serves as a synthesizing summary of what has gone before).[14] This treatment by continental unit is called *allgemeine Länderkunde* as opposed to *besondere Länderkunde*, treatment by regional units. The corresponding terms in the terminology proposed by James in his excellent discussion of the scale of geographical generalization[15] would be *macrochorography* and *mesochorography*. The treatment by continental unit, provided there is enough scope, as is the case here (90,000 words), makes for a breadth and sweep that are reminiscent of Penck's classic course at the University of Berlin on world regional geography.[16]

[14] See the methodological comments in two of the four regional volumes that have appeared so far: by Wagner (Allgemeine Länderkunde von Europa, Hanover and Leipzig, 1915, pp. 179–184) and by Machatschek, p. 169 of the work under discussion.

[15] P. E. James: The Terminology of Regional Description, *Annals Assn. of Amer. Geogrs.*, Vol. 24, 1934, pp. 78–86; reference on p. 85. The terms *microchoric, mesochoric, macrochoric* there suggested as alternatives seem to the writer far preferable to the originally proposed *topographic, chorographic, geographic*, because the first and third of the latter group of terms are already established in other meanings.

[16] The spirit of this is reflected in his opening lecture at Columbia University as exchange professor in 1908–1909: "North America and Europe: A Geographical Comparison," *Scottish Geogr. Mag.*, Vol. 25, 1909, pp. 337–346.

As to the books whose organization follows mainly the third type: The volume by Jones and Bryan is divided into three parts of different scope. One part deals with the main movements of American history and settlement and their geographical setting and thus is predominantly regional; another deals with the main resources and discusses their continent-wide distribution and economy; and a final part is avowedly regional and discusses one by one the regions (except the South) that make up the continent. Smith's book, although organized regionally (the author says, p. 33: "Since a continent cannot be presented as a whole, it must be divided into parts"), has an introductory chapter that gives a continental survey of the questions of economic geography with which the work throughout is chiefly concerned.

Among the books of the second type, Miller and Parkins' "North America," which is intended primarily as a normal-school and junior-college text, has two chapters on the continent as a whole and chapters that discuss the United States, Canada, and Mexico each as a unit. These are respectively followed by discussions advancing to a greater or lesser degree of regional subdivision as the treatment of the dominant economic activities may require.

The combination of continental and regional exposition together is fully developed, however, in the books by Schmieder, Blanchard, and Nelson.

All three are of considerable proportions (150,000–200,000 words), sufficient for a discussion of real scope. Their organization according to the modern viewpoint ensures the utilization of this space so that every page counts, as compared with the diffuse and repetitious treatment of the old encyclopedic and compendium methods. They differ somewhat in ratio of continental to regional part and also in topical emphasis, but these are differences of degree, not of kind. In Schmieder the regional part occupies about seven-eighths of the work, in Blanchard about six-sevenths. Nelson's work is divided into two equal parts, the first being a geography of the continent and the second a series of "regional and environmental descriptions" that, although not systematic regional discussions, in their completeness cover the whole continent. Swedish settlement in the United States and Canada is the subject of particular concern. In Schmieder emphasis is placed on the history of settlement, and each regional section contains an excellent portrayal on a large scale of the development of the natural into the cultural landscape. Blanchard, under each region, brings out the dominant characteristic and orients the discussion of the human geography around the most important economic activities.

These three works in their agreement reflect the tested method of treatment of a large unit in modern regional geography. The culmination of this method, as regards North America, is represented by Baulig's work, to which special attention will now be devoted.

Baulig's "North America," 1935–1936

If the record of what has gone before seems a long one, it is also one that leaves an impression of incompletely fulfilled achievement, of a goal yet to be attained. Sometimes, in the earlier days, professional competence was coupled with a lack of that "predilection" for the area in question that the editor of the North American volume in the first issue of Stanford's "Compendium" wisely considered a desirable attribute of geographical authorship, a conviction that led him at the last moment to assign the section on Canada to a Canadian contributor. Or, where native interest was at hand, the subject had not yet developed the point of view that could have made an adequate treatment possible. Even the few recent works just discussed that truly reflect the spirit of modern geography do not, in spite of their excellence, exhaust the possibilities, in a number of cases as a result of limitations of length, scope, or orientation imposed by the program of the series of which they form a part.

In Baulig's "North America," however, we have a work that is of sufficient length (315,000 words) to permit the adequate discussion of all essential features and topics. And yet this ample scope does not lead to verbosity or looseness of style. On the contrary there is a conciseness and informed restraint that convey a sense of power—the power that comes from consummate mastery of the material. For such it is. Every subject that has a bearing on geography, from geology and physiography to economics and the social sciences, has been drawn on where needed and with complete sureness of touch woven into a composite picture of the region under consideration. This, indeed, is the reconstruction of the totality of truth—real geographical synthesis.

Organization of the Work

The work is divided into three parts: North America as a whole (occupying about 30 per cent of the space), Canada (20 per cent), the United States (50 per cent). The ten chapters of the part on North America deal with: general features and relationships; the major lineaments of relief and structure; the surrounding seas; climate; the hydrography of the continent and its regime; vegetation, soils, and fauna; the Indians; the maritime discoveries and the foundation of colonies; the territorial development and peopling of the United States; and the same phenomena for Canada. The two parts dealing with Canada and the United States are organized according to their regional subdivisions; each part is concluded by an appraisal of the national economy and its outlook. Without any formal delimitation the continent is divided into eighteen regions, to each of which one chapter is devoted and in one case two. These are as follows (Arctic

Canada is omitted because dealt with under the Arctic in one of the other volumes of the series): Newfoundland and Labrador; the Maritime Provinces; the St. Lawrence Provinces; the Prairie Provinces and Northwest Territories; the Canadian West; Alaska; New England; the Middle Atlantic region; the Great Lakes and Ohio River region (between the Mississippi and the eastern border of the Appalachian Plateau), two chapters; the Prairies and the Great Plains; the Southeast and the Lower Mississippi flood plain; the Southwest (an introductory chapter on the South as a whole precedes these two); the Rocky Mountains; the Lower Columbia and Snake Plateaus; the Colorado Plateau; the Great Basin; California; the Pacific Northwest.

The Principle of the Predominant Characteristic

In the treatment of each region the routine consideration of the whole gamut of geographical elements in their systematic order is conspicuous by its absence. Instead, the principle of the predominant characteristic prevails.[17] The salient feature in each region is brought forward, while at the same time the contributing factors are skillfully portrayed as a background. In the South it is cotton; in the Southwest, oil; in the Rocky Mountains, relief and structure; in the Prairie Provinces, wheat on a background of climate, vegetation, and soils. The keynote is struck as a rule in brief introductory paragraphs of characterization.

Take, for example, Southern California, the discussion of which is reached in southward progression through the state:

> After their decrease in the southern part of the Great Valley and of the Coast Ranges human activities suddenly take on new vigor south of latitude 35° and, as the Mexican boundary is approached, attain a degree and variety of development that are remarkable. A mild and equable climate, an intensive agriculture, the exploitation of oil, and the utilization of the resources of the sea have here called into being and stimulated the development of a great city, with a busy port, specialized industries, and even a mode of life hitherto almost unknown in the United States.

Or this description of a great mountain system, with its corrective of sometimes loosely made comparisons:

> The Rocky Mountains are an orographic and structural unit that is characterized by the persistence of its general alignment; by the definiteness, and sometimes by the abruptness, of its topographical separation from the adjoining Great Plains on the east and the plateaus and Great Basin on the west; by its essentially sedimentary composition and the general absence of volcanic rocks and deep-seated igneous intrusions; by a relatively simple structure and the generally direct expression of

[17] In his "Dynamische Länderkunde" (Breslau, 1928) and "Das länderkundliche Schema" (Berlin, 1931) Hans Spethmann makes a vigorous plea for the application of this principle in all regional exposition. In the former he presents outlines, with the corresponding sketch drafts filled in, for the regional treatment of seven areas, for six of which published regional geographies organized according to the conventional "static" method exist. The whole question of method in regional exposition is fruitfully discussed by Hettner and Gradmann in articles called forth by Spethmann's two books (*Geogr. Ztschr.*, Vols. 34, 35, 37, 1928, 1929, 1931).

structure in relief; by usually slight erosional dissection; and by the frequent occurrence at high absolute elevations of the gentle slopes and rounded forms characteristic of *Mittelgebirge*. On the whole, the resemblance of the Rocky Mountains to the Alps is only a distant one; but, on the other hand, they differ distinctly from the Appalachians and the Hercynian mountains of Europe. Their similarities lie rather with mountains of intermediate geological age such as the Carpathians, where the results of early-Tertiary peneplanation go hand in hand with those of recent rejuvenation.

Or this cameo of New England:

With her often refractory soil, her inhospitable climate, her bountiful sea; with her early population of small farmers, seamen, fishermen, and merchants, marked with the deep impress of religious sectarianism and the collective discipline of rural and urban community life; then weakened by the drain to the West and the movement to factory and city and later nearly submerged by an alien flood; frequently ousted from political control of her own destinies and condemned to economic readjustments without end—nevertheless, she has been able to perpetuate that prudent reserve, that civic sense, and that practical spirituality for which she stands and, owing to her cultural institutions, has made the influence of her spirit felt through the length and breadth of the land.

Physical Geography the Stable Foundation

Whereas the principle of emphasis on predominant aspect underlies the organization of the work, physical geography constitutes its stable foundation throughout. The author, like the school from which he stems, is convinced of the truth of the poet's dictum that "to the solid ground of Nature trusts the mind that builds for aye." Of every region, as of the continent as a whole, there is a masterly outline of relief and structure—not a discussion of local physiographic processes or geological history but a description of major surface features in terms of the large-scale forces to which they owe their origin. These outlines are illustrated by superb, critically selected air photographs with trenchant explanatory captions and by a number of physiographic maps, of which the more important are a series of three covering the United States, one from the Atlantic to the Mississippi on the scale of 1 : 8,000,000, another from the Mississippi to the Rockies in 1 : 10,000,000, and the last of the Cordilleran West in 1 : 6,500,000. Here are portrayed with utmost clarity oldlands and coastal plains, cuestas and scarps, mountain massifs of differing structure and age, sunken basins, Pleistocene lakes, edges of the ice sheet, alluvial plains, plateaus, block mountains, faults, lava flows, intermontane parks, desert plains. The symbolism of these maps, like that of a number of earlier maps,[18] incidentally demonstrates the feasibility of devising ground-plan symbols, instead of perspective symbols, for a wide range of physiographic types.

[18] De Martonne's physiographic map of the Carpathians, 1 : 2,500,000, *Geogr. Rev.*, Vol. 3, 1917, Pl. IV, and Zaborski's map of the surface features of Poland and Lithuania, 1 : 1,250,000, Warsaw, 1928. The tectonic maps in the different volumes of Hettner's "Grundzüge der Länderkunde" represent a successful solution of the problem on small scales.

Other aspects of physical geography are also constantly taken into account. Although climate and vegetation are discussed in the general part dealing with North America as a whole, these subjects are enlarged on in the regional sections where the special character of the region calls for it, such as the rainfall, grasslands, and soils of the Great Plains, the forests of British Columbia and the Pacific Northwest, the aridity of the Great Basin.

Population and National Economy

It is hardly necessary to say that human geography comes in for its full share of consideration.

In the four general chapters dealing with the peopling and the national economy of Canada and the United States the whole range of questions is discussed—population growth and distribution; natural resources, mineral, water, forest, and soil; agriculture and its problems, especially in their recent aspects; industry, commerce, transportation; international relations and world position. These are chapters of broad sweep and wide horizon, yet supplied with the same wealth of specific facts and figures that characterizes the work throughout and informed with the knowledge and understanding of national problems and trends, even to their minutiae, the foundation of which was laid by the author's long residence and travel in the United States and later by his constant contact with American sources.[19]

Accompanying the discussion of population there is an original, colored distribution map on the scale of 1 : 15,000,000 based on the United States census of 1930 and the Canadian census of 1931. Rural population is represented by density grades (six in all), which scheme, as the author says in the explanatory note to the map, "better than all other devices of equal simplicity portrays the relationship of man to the earth." Urban population is indicated by city symbols of different sizes and by deeply colored areas for the metropolitan districts.

Cities are accorded special attention. In the discussion of industrial districts the cities are characterized by various criteria, such as size and dominant industries, and, in the case of southern New England, by number of salaried employees in addition (a map with ingenious symbolism shows this). The discussion of major cities, which is illustrated by air photographs, includes a consideration of site, development, and function and, for the largest, a characterization of neighborhoods.

In the field of population questions and forecast two quotations

[19] Professor Baulig, who now occupies the chair of geography at the University of Strasbourg, is one of the original group of pupils of Vidal de la Blache. He has specialized in the geography of North America for over thirty years, since he became familiar with the United States from a four-year sojourn as a University instructor at Harvard and elsewhere early in his career. In 1912 he took part in the American Geographical Society's Transcontinental Excursion.

will have to suffice to illustrate the author's treatment. With regard to the future of Canadian population growth[20] he says:

No one still believes in the forecasts that, too confident of the value of extrapolation, predicted a population of several tens of millions for the Canada of the middle of the twentieth century. The probabilities are, rather, that there will be a very gradual increase at a constantly diminishing rate and that stabilization will take place in the relatively near future at a moderate figure. For, here as well as in the United States, or maybe more so, the character of the country and the spirit of the New World call for the availability of large areas and freedom in space relations.

As to Alaska:

If Alaska is not the icy, barren waste it was long imagined to be, neither is it a settler's country for the immediate future, as some have dreamed of it. Owing to its location on the border of the inhabited world, far from the great centers of population, beyond the main currents of trade, Alaska's undeniably valuable resources would come fully into their own only if the world became overcrowded or if constantly increasing consumption reduced the reserve of basic materials to the danger point. In waiting for that day, doubtless far distant, Alaska can continue to furnish regularly, under farsighted management, its quota of products from fisheries, forests, and mines.

In introducing the discussion of the effect of the world crisis on Canadian economy the author gives a clue to his conception of the geographical treatment of economic questions.

It is certainly not the concern of geography to follow step by step a development in which all sorts of financial, monetary, political, and moral factors are operative—for these are certainly devoid of all geographical character. But it is the concern of geography to point out what, in the economic structure of a given country, is in conformity with its nature and what is simply artificial or adventitious. In this respect the world crisis acts as a catalyst, segregating the weak and the strong parts of the structure. We shall see that the strong elements in Canadian economy are usually those that rest on the firmest geographical foundations.

In keeping with this point of view such topics as agriculture, the coal and petroleum industries, forestry and the lumber trade are discussed in their regional setting. Because of the nature of these themes it is difficult to encompass them in a short generalizing characterization, and, for lack of such by the author, no quotations can here be offered to illustrate his method. There are two passages, however, on Southern agriculture that by combination and condensation lend themselves to quotation and, because of their comparison with European conditions, are of special interest. This combined passage is here submitted in conclusion:

On the cultivation of cotton there has been erected since the Civil War what amounts to a financial system whose aim it is to reincorporate the emancipated negro into Southern economy. After unsuccessful attempts to employ negro labor on a wage basis, the solution was found in the institution of tenancy. There were various

[20] For an analysis of the elements likely to govern future population growth in Canada see Griffith Taylor: Fundamental Factors in Canadian Geography, *Canadian Geogr. Journ.*, Vol. 12, 1936, pp. 161–171.

degrees, but common to all was the device of large advances in money to the tenant. The system succeeded so well, at least from the point of view of the producer, that it was extended to tobacco, resulting in the same social consequences. Further proof of its success was the fact that it was extended to the whites. In six cotton states white tenancy increased from 30 to a hundred in 1880 to 61 to a hundred in 1930 . . . In short, under one form or another this system has made of the tiller of the soil an agricultural servant without fixed wages, concerned willy-nilly in the success of an enterprise over which he has but little or no control. And as there are no hard and fast lines between cropper, share tenant, and cash tenant, and as even the small owner-operator may in bad years be forced into the ranks of the tenants, there results—a new phenomenon in the United States—a large agricultural proletariat, white and black, already more white than black, a class of peasantry who own their bodies but are held in economic bondage, a class the like of which has for centuries no longer existed in western Europe.

Conclusion

With these quotations and this commentary it has been attempted to convey some idea of the scope and method of Baulig's work. Only a perusal of the work itself can give an adequate conception of its significance. On laying it down and looking back over the long list of geographies of North America that have appeared in the last sixty years one is inclined to agree with the doctrine to which in another and yet not wholly unrelated domain the author refers—the doctrine *qui enseigne que la qualité vaut mieux que le nombre*. The present work and the others in the same series seem to prove it.

Titles and Bibliographical Details of Works Cited in Table I

Reviews are indicated in brackets following an entry. Abbreviations of periodicals: GR *Geogr. Rev.*, BAGS *Bull. Amer. Geogr. Soc.*, GJ *Geogr. Journ.*, PM *Petermanns Mitt.* (Lb "Literaturbericht"). See also next-to-last paragraph in explanation at bottom of table.

German and Austrian

Friedrich von Hellwald: Die Erde und ihre Völker: Ein geographisches Hausbuch, 2 vols., 2nd edit., Stuttgart, 1877 (A, Vol. 1, pp. 3–11, NA pp. 12–203); 4th edit., 1898. [PM, 1878, p. 84]

Friedrich Ratzel: Die Vereinigten Staaten von Nord-Amerika, 2 vols. (Vol. 1: Physikalische Geographie und Naturcharakter, 667 pp.; Vol. 2: Culturgeographie . . . unter besonderer Berücksichtigung der wirthschaftlichen Verhältnisse, 762 pp.), Munich, 1878 and 1880. Second edition of Vol. 2: Politische Geographie unter besonderer Berüchsaichtigung der natürlichen Bedingungen und wirthschaftlichen Verhältnisse, 763 pp., 1893). [PM, 1880, p. 237; 2nd edit. of Vol. 2, PM, 1894, Lb 236]

[Scobel 1882] Richard Andree, editor (from 1894 issue on, A. Scobel, edit.): Geographisches Handbuch zu Andrees Handatlas, Leipzig, 1882 (NA pp. 416–515 by A. Scobel); 1st edition edited by Scobel, Leipzig, 1894; 2nd edit., 1895; 3rd edit., 1899 (NA, pp. 673–745); 5th edit., 2 vols., 1910 (NA Vol. 2, pp. 290–383).

Franz Heiderich: Adrian Balbis Allgemeine Erdbeschreibung, 8th edit., completely revised by F. Heiderich, 3 vols., Vienna, 1893–94 (A, Vol. 1, 1893, pp. 385–510, US pp. 511–621, C pp. 762–781). [PM, 1893, Lb 611]

[Deckert 1893] Wilhelm Sievers, associated with E. Deckert and W. Kükenthal: Amerika, Eine allgemeine Landeskunde, Leipzig, 1893 (A, pp. 3–56; NA, by Emil Deckert, pp. 365–606).

Friedrich Ratzel: Geographische Übersicht *in* Baedeker's Vereinigte Staaten: Handbuch für Reisende, Leipzig, 1893; 2nd edit., 1904.

Franz Heiderich: Die Erde, 876 pp., Vienna, 1896; 3rd edit. entitled "Die Erde: Eine allgemeine Erd- und Länderkunde," two parts in one vol., 1923 (A, Part 2, pp. 422–428; NA pp. 428–460). [1896 edit., PM, 1897, Lb 6; 1923 edit., PM, 1924, Lb 28]

Alfred Hettner: text to Spamers Grosser Handatlas, Leipzig [1897?] (NA, pp. 129–138).

Franz Heiderich: Länderkunde der aussereuropäischen Erdteile (Sammlung Göschen No. 63), Leipzig, 1897; 4th edit., 1921 (A, pp. 106–120; NA, pp. 120–136).

(*continued on p. 660*)

TABLE I—REGIONAL GEOGRAPHIES OF NORTH AMERICA, OR OF THE UNITED STATES OR CANADA SEPARATELY, PUBLISHED SINCE THE DEVELOPMENT OF MODERN GEOGRAPHY

(For explanation of abbreviations and symbols, see bottom of table)

GERMAN AND AUSTRIAN	FRENCH	BRITISH (incl. CANADIAN)	AMERICAN	SCANDINAVIAN
ld NA 85° 1877 d ed.; 4th ed. 1898) US 550 1878–80 d ed. of polit. geogr. 1881)				Löffler NA 000° 2nd ed. 1878 (3rd ed. 1885)
NA 70° 1882 d ed. 45° 1899; 5th ed. 1910)	Vogel NA 115° 1884	Selwyn C 115° 1883 [Selwyn and G. M. Dawson Phys. geogr. C 20 1884]	Hayden US 95° 1883 Shaler Physiogr. of NA 15° 1884 Whitney US 140 1889 (with suppl. 100 1894)	
rich NA 110° 1893 ert NA 145° 1893 l US 00° 1893 d ed. 1904) rich NA 00° 1896 d ed. 20° 1923) er NA 13° 1897? rich NA 00° 1897 h ed. 13° 1921)	Reclus C 145° 1890 (Engl. transl. 1893) Reclus US 265 1892 (Engl. transl. 1893)	Greswell C 42 1891 G. M. Dawson C 00° 1892 (2nd ed. 55° 1904) G. M. Dawson C 00° 1894 (2nd ed. 0000; 3rd 1907; 4th 9° 1922) [Handbook of C, geogr. part 120° 1897] S. E. Dawson C 215 1897 Tyrrell C 15° 1899 (2nd edit. 1908)	Shaler NA 84 1891 Shaler NA 90 1892 Shaler US 00° 1893 (2nd ed. 1899; 3rd 1904; 4th 5° 1909) Shaler and others US, geogr. part 275 1894 [Physiogr. US 130 1896] Gannett US 140 1898 Davis NA 7° and US 31° 1899 (2nd edit. 1908)	Löffler NA 00° 1893–98
ert NA 305 1904 d ed. 315 1913) l C 60 1906 n NA 55° 1907 sed on Deckert 1904) er US 45 1908		Herbertson NA 80 1901 Rogers C 80 1911 Herbertson NA 34° 1912? Oxford Survey C 120° 1914	Russell NA 140 1904 (2nd ed. 140 1927) [Bowman US, regional part 225 1911]	
ert Econ. geogr. US and C 100° 1913 parate 90° 1916)] l NA 25° 1914 d ed. 1922)	Kergomard US 85° 1914 Lamothe C 33° 1914	[Brock C 28° 1914] Ami C 315 1915		
l NA 20° 1921 lton C 100 1921 ert US 80 1922] er A 75 1923 ner NA 32° 1924 h ed. 35° 1930) Hatschek NA 150 1924 sed on Deckert NA 1913)	Granger NA 55° 1922 (3rd ed. 1931)	[Handbook of C, geogr. part 125° 1924] Jones and Bryan NA 218 1924 (2nd ed. 230 1928)	Huntington NA 40 1919 [Colby NA 215 1921] [Lobeck Physiogr. map US 1921 and text 20 1922]	Vahl and Hatt NA 175° 1922 Nelson C 45 1922
nasch NA 90° 1926 rich US 35 1926 ert NA 75° 1927] ng NA 10° and US 18° 1927	Allix NA 00° 1926		Smith NA 325 1925	Nelson NA 160 1926 (2nd ed. 195 1935)
llon C 12° 1927 ert NA 28° 1927 Hatschek NA 90 1928 NA 90° 1929	Cestre US 250 1927	Newbigin NA 22° 1929	Brigham US 87 1927 Miller and Parkins NA 175 1928 (2nd ed. 185 1934)	
e NA 35° 1930			[Fenneman Western US 175 1931] [Jefferson Man in U. S. 29 1933]	
rich NA 150° 1933 nader NA 165 1933 ert NA 30° 1935	Blanchard NA 155 1933 Baulig NA 315 1935–36			Rosberg NA 000° 1935?

ks are cited by author, area described, length, and date. Areas abbreviated thus: A the two Americas, NA North America, nada, US United States. Length is given in approximate num- of words in thousands (000s omitted). An asterisk following the ber of words means that the account is not an independent unit forms part of a volume that includes other areas. Works whose th is indicated by ciphers have not been seen by the writer. s enclosed in brackets are exceptional in that they discuss only e aspects of the given area, such as physical geography or eco- geography, or constitute a group of articles by, or quotations various authors, or differ in some other way. The chrono- al placing of a work is by its date of first publication. Later ons are referred to in parentheses.

e area forming the basis of the present survey is primarily lish-speaking North America. However, works discussing th America as a whole usually include the whole continent ward at least as far as the Isthmus of Tehuantepec. Mexico therefore be included in some of the accounts here abbreviated as NA. On the other hand, in the case of works organised by countries, only British North America and the United States (including Alaska) have been taken into consideration and, if by the same author and in the same volume, have been jointly designated by NA. For further details as to the regional structure of the works see the following list of titles.

The works cited in the table may be identified in this list of titles, where they are enumerated by nationalities in the same order as in the table. To facilitate identification in the case of collective works the entry is preceded in brackets by author and date as given in the table.

Owing to lack of space Italian works have been omitted from the table. They are: Porena NA 100° 1897, Errera NA 175° 1934, and Michieli, NA 180 1935 (bibliographical details will be found in the list of titles). If inserted in the table they would fall in a column between the German-Austrian and French columns, in keeping with the fact that Italy, chronologically, was the second nation to introduce modern geography.

Emil Deckert: Nordamerika (Series: Allgemeine Länderkunde), 608 pp., Leipzig, 1904 (designated 2nd edit., i. e. of Deckert 1893 above; 3rd edit., 612 pp., 1913) [BAGS, 1906, p. 332; PM, 1905, Lb 190; 1913 edit., PM, 1914, II, p. 91]

Alwin Oppel: Landeskunde des Britischen Nordamerika (Sammlung Göschen No. 284), 154 pp., Leipzig, 1906. [PM, 1907, Lb 232]

Wilhelm Sievers: Allgemeine Länderkunde, Kleine Ausgabe, 2 vols., Leipzig, 1907 (NA, based on Deckert 1904, Vol. 1, pp. 152–252). [PM, 1909, Lb 1]

Henrich Fischer: Landeskunde der Vereinigten Staaten von Nordamerika (Sammlung Göschen Nos. 381 and 382), 2 vols. (Vol. 1, 115 pp.; Vol. 2, 103 pp.), Leipzig, 1908. [PM, 1909, Lb 636]

[Deckert 1913] Karl Andree's Geographie des Welthandels. New edition edited by Franz Heiderich and Robert Sieger, 4 vols., Frankfurt, 1910–21 (US and C, by Deckert, in Vol. 3, 1913, pp. 305–538; published separately *in* Die Länder Nordamerikas in ihrer wirtschaftsgeographischen Ausrüstung, Frankfurt, 1916, C and US, pp. 1–204). [PM, 1914, II, pp. 149–150; 1916 version, PM, 1917, p. 128]

[Oppel 1914] Ewald Banse: Illustrierte Länderkunde, Brunswick, 1914 (NA, by A. Oppel, pp. 274–325); 2nd edit., 1922. [GR, Vol. 3, 1917, pp. 84–85, by Jefferson; PM, 1914, II, pp. 284–285; GJ, Vol. 46, 1915, p. 313]

[Oppel 1921] Oskar Kende, edit.: Handbuch der geographischen Wissenschaft, 2 vols., Berlin, 1914 and 1921 (A pp. 713–716, NA pp. 747–779, by A. Oppel, in Vol. 2).

Louis Hamilton: Canada ([F. A.] Perthes: Kleine Völker- und Länderkunde, Vol. 8), 256 pp., Gotha, 1921.

Kurt Hassert: Die Vereinigten Staaten von Amerika als politische und wirtschaftliche Weltmacht geographisch betrachtet, 315 pp., Tübingen, 1922. [PM, 1923, Lb 604]

Karl Sapper: Amerika: Eine Übersicht des Doppelkontinents (Sammlung Göschen Nos. 855 and 856), 2 vols. (Vol. 1, Physische Erdkunde, 112 pp.; Vol. 2, Geographische Kulturkunde, 156 pp.). Berlin, 1923. [PM, 1923, Lb 479]

Alfred Hettner: Grundzüge der Länderkunde, 2 vols. (Vol. 1: Europa; Vol. 2: Die aussereuropäischen Erdteile), joint 1st and 2nd edits., Leipzig, 1923–24 (NA, Vol. 2, pp. 280–351); 4th edit., 1930 (NA, pp. 303–378). [GJ, Vol. 64, 1924, pp. 491–493, by Ogilvie; GR, 1926, pp. 343–344]

[Machatschek 1924] Emil Deckert: Nordamerika, 4th edit. competely revised by Fritz Machatschek (Series: Allgemeine Länderkunde), 355 pp., Leipzig, 1924. [PM, 1925, Lb 490]

Hermann Lautensach: Ein Handbuch zum Stieler, 2 vols. (Vol. 1: Allgemeine Geographie; Vol. 2: Laenderkunde), Gotha, 1926 (A pp. 653–672, NA pp. 673–726, in Vol. 2). [GJ, Vol. 70, 1927, p. 310; PM, 1927, pp. 97–99]

Bruno Dietrich: U. S. A.: Das heutige Gesicht, 150 pp., Breslau, 1926. [PM, 1927, Lb 142 (review by author himself)]

[Hassert 1927] Karl Andree's Geographie des Welthandels, 4th edit., edited by Franz Heiderich, Hermann Leiter, Robert Sieger, 3 vols., Vienna, 1926–30 (NA, by K. Hassert, in Vol. 2, 1927, pp. 585–757). [GR, 1928, pp. 520–521; PM, 1927, Lb 462]

[Lebling 1927] Walter Gerbing, edit.: Das Erdbild der Gegenwart: Eine Schilderung der Erde und ihrer Länder . . . , 2 vols., Leipzig, 1926–27 (A pp. 543–544, NA pp. 544–576, US pp. 587–653, all by Clemens Lebling in Vol. 2, 1927). [PM, 1928, Lb 308]

[Hamilton 1927] Walter Gerbing, *op. cit.* (C, by Louis Hamilton, Vol. 2, pp. 587–614). [PM, 1928, Lb 308]

[Hassert 1927] K. Krause and R. Reinhard, edits.: Handbuch [der Geographie]: E. von Seydlitz'sche Geographie, Hundertjahr-Ausgabe, 4 vols., Breslau, 1925– (A pp. 425–430, NA pp. 431–496—photographs pp. 497–528—by K. Hassert in Vol. 3, 1927). [GJ, Vol. 71, 1928, pp. 606–607; PM, 1928, Lb 217]

Fritz Machatschek: Allgemeine Länderkunde von Nordamerika (Series: Allgemeine Länderkunde der Erdteile, edited by Wilhelm Meinardus, Vol. 4), 195 pp., Hanover, 1928. [PM, 1930, Lb 320]

Willi Ule: Die Erde und ihre Völker: Ein geographisches Handbuch, 2 vols. (Vol. 1: Europa, Afrika; Vol. 2: Asien, Australien und die Südseeinseln, Amerika, die Polarländer), Stuttgart, 1928–29. [PM, 1931, Lb 10]

Ewald Banse: Das Buch der Länder: Landschaft und Seele der Erde, 2 vols. (Vol. 1: Das Buch Abendland; Vol. 2: Das Buch Fremdland), Berlin, 1929–30 (A pp. 11–16, NA pp. 17–91 in Vol. 2). [PM, 1931, pp. 30–31, by von Drygalski; GJ, Vol. 76, 1930, p. 173]

[Dietrich 1933] Fritz Klute, edit.: Handbuch der geographischen Wissenschaft, 12 vols. in course of publication, Potsdam, 1930– (NA, by B. Dietrich, pp. 1–389, *in* Bruno Dietrich and others: Nord- und Mittel-Amerika [und] die Arktis in Natur, Kultur und Wirtschaft, 1933).

Oscar Schmieder: Länderkunde Nordamerikas: Vereinigte Staaten und Canada (Enzyklopädie der Erdkunde, edited by Oskar Kende, Vol. 27), 436 pp., Vienna, 1933. [PM, 1934, Lb 182]

Max Eckert: Neues Lehrbuch der Geographie, 3 vols., Berlin 1931–35 (A pp. 1339–1341, NA pp. 1341–1402, in Vol. 3, 1935).

Italian

[Porena 1897] Giovanni Marinelli and others: La Terra: Trattato popolare di geografia universale, 8 vols., Milan, 1883–1901 (A pp. 3–14, NA pp. 15–198, by Filippo Porena, in Vol. 7, 1897?).

[Errera 1934] Roberto Almagià, edit.: Geografia Universale Illustrata, 8 vols., Turin, in course of publication since 1934 (NA, by Carlo Errera, Vol. 6, 1934, pp. 4–428). [PM, 1934, Lb 171; GJ, Vol. 84, 1934, pp. 530–531]

A. A. Michieli: America del Nord in generale e Canadà (Terra e Nazioni, Series 1, Vol. 1), 352 pp., Milan, 1935.

French

Charles Vogel: Le monde terrestre au point actuel de la civilisation: Nouveau précis de géographie comparée, 3 vols. in five, Paris, 1877–84 (A pp. 1–71, NA pp. 109–294, in Vol. 3, Part 3, 1884).

Élisée Reclus: Amérique boréale (Nouvelle Géographie Universelle: La terre et les hommes, Vol. 15), 723 pp., Paris, 1890 (A pp. 1–87, Greenland and Arctic Archipelago pp. 89–185, Alaska pp. 187–253, C pp. 255–699). (English translation: North America, edited by A. H. Keane, Vol. 1: British North America (Series: The Earth and Its Inhabitants, [Vol. 15]), 496 pp., New York, 1893).

Élisée Reclus: Les États-Unis (same series, Vol. 16), 847 pp., Paris, 1892. (English translation: North America, edited by A. H. Keane, Vol. 3: The United States (Series: The Earth and Its Inhabitants, [Vol. 17]), 504 pp., New York, 1893). [BAGS, 1892, pp. 379–390; PM, 1894, Lb 5]

[Kergomard 1914] Onésime Reclus, edit.: Grande Géographie Bong Illustrée: Les pays et les peuples, 5 vols., Paris, 1911–14 (US, by J. G. Kergomard, Vol. 5, 1914, pp. 43–136). [GR, Vol. 10, 1920, pp. 116–118]

[Lamothe 1914] Onésime Reclus, *op. cit.* (C, by H. de Lamothe, Vol. 5, pp. 3–40). [GR, Vol. 10, 1920, pp. 116–118]

Ernest Granger: Nouvelle Géographie Universelle: Le monde nouveau, 2 vols., Paris, 1922 (A pp. 242–250, NA pp. 250–314, in Vol. 2); 3rd edit., 1931. [GJ, Vol. 63, 1924, p. 360]

[Allix 1926] Maurice Allain, edit.: Géographie Universelle Quillet: Physique, économique, humaine, 4 vols. and 2 atlases, Paris, 1923–26 (NA, by [Madame] J. Allix, Vol. 4, 1926, pp. 393–427). [Bibliogr. Géogr., Vol. 33 for 1923, entry 481; Vol. 36 for 1926, entry 735]

Charles Cestre: Les États-Unis, 338 pp., Paris, 1927. [*Annales de Géogr.*, 1929, pp. 175–177]

Raoul Blanchard: L'Amérique du Nord: États-Unis, Canada, et Alaska (Series: Géographie Pour Tous), 399 pp., Paris, 1933.

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THE GEOGRAPHY OF THE OCEANS

A REVIEW OF THE WORK OF GERHARD SCHOTT*

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AN account of the history of geographical knowledge must pause reverently before the names of Eduard Suess and Julius Hann. Each devoted a lifetime to the collection and organization of knowledge about the earth, the one regarding the geologic structure and surface features, the other regarding the climatic conditions. Now once again we are indebted to the genius of the Germans for having produced another compendium to stand with those earlier classics. Henceforth with these other two names we must associate the name of Gerhard Schott, whose monumental work on the oceans completes this trilogy on land, air, and water.

The material set forth in Schott's two volumes is impressive not only because of its amount and detail but also because of the range of its subject matter. In addition to the many sections dealing with the various items of the hydrology, the climatology, and the configuration and geologic structure of the ocean basins, the author includes several chapters dealing with the history of discovery and exploration, the present sailing and steamship routes, the airplane routes, the flow of commerce, and the location and character of the fishing and whaling industries. In both volumes, too, there is a chapter on marine life contributed by Professor E. Hentschel. The text is supplemented by an abundance of maps and diagrams. In the volume on the Atlantic there are 27 charts of the ocean as a whole giving the distribution of various elements of the geology, configuration, hydrology, and climatology. In the volume on the Indian and Pacific Oceans there are 37 such charts. A truly remarkable compendium of information; but one intended as a work of reference, not for steady reading.

No volumes as comprehensive as these could be of uniformly superior quality. Certain parts do not measure up to the high standard set by the work as a whole. Especially is this true of the geological treatment in the "Atlantic Ocean." The map showing structural features bordering the oceans (Pl. 3) requires considerable revision in the light of facts that were already well established before the publication of the second edition. In this same volume the map of the ocean currents (Pl. 15) needs revision now on the basis of new information that has appeared since 1926. On the other hand, the wealth of new oceanographic material is excellently presented in the book on the Indian and Pacific Oceans. In both works the general circulation of the atmosphere and the cyclonic storms of middle latitudes are given the conventional treatment, with no reference to the new air-mass climatology. Obviously the far-reaching concepts involved by this new approach could not be taken into account even in the second edition of the volume on the Atlantic, the revision of which was undertaken in 1923–1926; and the preparation of the volume on the Indian and Pacific Oceans came just a bit too early (1929–1934) to make possible the organization of the discussion of the meteorology according to the new doctrine. Regarding the importance of the climatic information, however, there can be no question. In fact, it was Schott's new rainfall data for the Indian and Pacific Oceans that, in 1934, made possible the compilation by Meinardus of a revised world picture of rainfall distribu-

*Gerhard Schott: Geographie des Atlantischen Ozeans, Hamburg, 1912 (reviewed in *Bull. Amer. Geogr. Soc.*, Vol. 45, 1913, pp. 378–380); 2nd edit., Hamburg, 1926 (reviewed in *Geogr. Rev.*, Vol. 17, 1927, p. 164). *Idem:* Geographie des Indischen und Stillen Ozeans, xix and 413 pp., C. Boysen, Hamburg, 1935.

tion.[1] Despite the shortcomings of the geological sections, the configuration of the ocean basins is admirably portrayed on large folded maps on which the vertical interval is chosen most effectively to bring out the pattern of the great submarine ridges, the broader depressions, and the deeps.

The Circulation of the Ocean Water

Schott's treatment of the circulation of the water in the Indian and Pacific Oceans represents a significant revision of the conventional portrayal of the phenomena involved. The ocean water, says Schott, can no longer be described as moving clockwise in the northern hemisphere and counterclockwise in the southern hemisphere around a central area with no definite surface current. To be sure, there is a tendency toward such a movement in all the oceans except the Indian Ocean north of the equator. Fundamentally the surface currents are related to the direction of the prevailing wind, moving a little to the right of the wind direction in the northern hemisphere and to the left of the wind direction in the southern hemisphere. But it seems that the several parts of the system do not in every case join directly with other parts, and the Sargasso Sea of the North Atlantic is the only example of the central area without definite surface movement. The North Pacific may serve to illustrate the new concept.

In the low latitudes of the North Pacific the prevailing easterly winds produce a west-moving current of water, which, under the influence of the earth's rotation, tends constantly to swing to the right, or north. In the middle latitudes, urged on under the prevailing westerly winds, is an east-moving current of water, which also tends to swing to the right, or south. On the Asiatic coast the rebounding waters are turned in part toward the north, to form the warm Kuroshio; and along the California coast the currents are similarly deflected southward into the low latitudes. Elsewhere, however, the two parts of the movement meet along a sharp line. This "convergence" of waters of different physical and biological character does not result in a new current or in the development of water that partakes of the characteristics of the two converging currents. Instead the denser waters tend to sink and pass under the lighter ones; and mixture takes place only slowly through a zone in which one encounters detached but homogeneous masses of water first from one side of the convergence, then from the other. Such a discontinuity as is found between the Gulf Stream and the Labrador Current is not unique but is repeated, perhaps with not quite such striking contrast, in various parts of the several oceans.

The Convergences

As in the case of all other phenomena on the face of the earth that are directly or indirectly related to the climatic features, there is a tendency toward symmetry in the pattern of arrangement. Departures from the symmetrical arrangement as regards the ocean currents are due to the asymmetrical configuration of continents and ocean basins. In both hemispheres there are two major lines of convergence where water masses differing in temperature, salt content, life forms, and color are in contact. These are known as the "polar convergence" and the "subtropical convergence." Schott recognizes in each hemisphere three contrasted types of water, separated by these convergences. In the high latitudes are the "polar waters," characterized in general as low in temperature, low in salt content, rich in plankton, and greenish in color.[2] These currents, also, frequently carry drift ice and icebergs. In the low latitudes are the "subtropical waters," generally

[1] Wilhelm Meinardus: Eine neue Niederschlagskarte der Erde, *Petermanns Mitt.*, Vol. 80, 1934, pp. 1–4; reviewed by Mark Jefferson, *Geogr. Rev.*, Vol. 24, 1934, pp. 520–521.

[2] Schott includes a map of the ocean color (Pl. 7) in his volume on the Atlantic Ocean.

high in temperature, high in salt content, low in organic forms, and blue in color. In between lie the so-called "mixed waters" of the middle latitudes.[3]

The distribution of these various kinds of ocean water and the convergences that separate them is not strictly latitudinal. The east coasts of the continents are bathed by poleward-moving currents of subtropical water, the west coasts at the same latitudes by relatively cold, equatorward-moving currents. Because of the configuration of the ocean basins the warm, east-coast currents of the Atlantic and the Pacific Oceans are best developed in the northern hemisphere, the cold, west-coast currents in the southern hemisphere. Where currents tend to swing offshore, cold water wells up from below.

Seasonal Changes

The seasonal shift of these currents and lines of convergence differ in the different oceans. In the South Pacific the currents may vary in rate and steadiness of flow, but the arrangement remains essentially the same throughout the year. In the North Pacific, on the other hand, the lines of convergence shift about 5° toward the north in the northern summer and thus make room for the Equatorial Countercurrent, lying between latitudes 5° and 10° N. The increased size of this countercurrent in August and September seems to be due to the large amount of subtropical water moving westward at this time in the South Equatorial Current, which is returned eastward through the countercurrent. This situation may be contrasted with the conditions in the Atlantic Ocean, where the eastward return of the subtropical waters is accomplished in a different manner. Here the projecting nose of South America divides the South Equatorial Current, deflecting a part of it toward the north. Both this deflected part of the southern-hemisphere subtropical waters and the waters of the North Equatorial Current enter the Caribbean and the Gulf of Mexico and emerge to form the powerful Gulf Stream. Through this stream most of the Atlantic waters are returned eastward. The relative weakness of the Kuroshio can be matched against the relatively slight development of an equatorial countercurrent in the Atlantic—a contrast between the two oceans that is due either directly or indirectly to differences in the configuration of the continents and the ocean basins.

The passage of the seasons witnesses a more radical change in the Indian Ocean. In February there is a well developed westerly movement of the subtropical water both north and south of the equator. These currents, striking the coast of Africa, give rise to a strong countercurrent—in this ocean lying south of the equator—and to the Agulhas Current off South Africa. In August, on the contrary, the onshore south Asiatic monsoon reverses the direction of the North Equatorial Current, so that the countercurrent entirely disappears. The currents in the Bay of Bengal and among the East Indies are similarly reversed by the seasonal shift of the winds.

The Natural Regions of the Oceans

The popular terminology of seafaring people, including such designations as the "roaring forties," the "doldrums," and the "Sargasso Sea," has long suggested the possibility of dividing the oceans into natural regions; but, strangely enough, no such systematic division had been attempted before Schott took it in hand. In the earlier work, on the Atlantic, four different regional systems were used. One divides the ocean into various basins and plateaus on the basis of its bottom configuration (Fig. 30);[4] another division is on the basis of hydrologic characteristics (Fig. 50); a system of climatic regions is presented (Fig. 77); and finally, in Dr.

[3] On this classification see *Geogr. Rev.*, Vol. 26, 1936, p. 490, footnote 3.

[4] See the recent regional scheme of this kind presented by Georg Wüst: Die Gliederung des Weltmeeres: Versuch einer systematischen geographischen Namengebung, *Petermanns Mitt.*, Vol. 82, 1936, pp. 33–38.

Hentschel's chapter on the life of the oceans, a regional division based on the distribution of organisms is used (Fig. 89).[5] In the later volume, on the Indian and Pacific Oceans, however, Schott attempts to synthesize into one set of natural regions all the various diverse elements combined in the upper layers of the ocean and the lower layers of the atmosphere. He has extended the scheme to the Atlantic[6] and has now published a world map of oceanic regions[7] (compare Fig. 1).

This attempt at a regional synthesis of the oceans raises several questions involving the broader theory of regions. A region is a geographic generalization and in common with all other generalizations is established on the basis of the recognition of general similarities and the disregard of specific differences. The purpose of any generalization is the assertion of similarities among diverse things; for example, that men are taller than women, or that in the long run supply and demand tend to become equal. But generalizations that get too far from the specific facts that support them are weak; and this is very apt to be the case where an attempt is made to recognize rather vague similarities among elements that are not only diverse but characterized by different kinds of diversity.

The so-called geographic region is an example of this. The totality of the landscape, which the geographic region attempts to generalize, is composed, among many other features, of such fundamentally different groups of things as landforms (produced by physical processes) and the forms of the human occupance (with origins traceable to long-established custom, technical ability, economic status, and, now and then, unpredictable flashes of creative imagination). Experience is tending to show more and more certainly that the concept of the geographic region, especially in the hands of insufficiently trained people, serves more frequently to obscure well known relationships than to reveal new ones.

This brings to mind Passarge's dilemma regarding the boundaries of a theoretical *landschaft*.[8] He postulates two unit areas, one a hilly or mountainous surface covered with forest, the other a plain mostly cleared of forest. In one place, however, the forest boundary overlaps the plain. At some length Passarge discusses the question of where the *landschaft* boundary is to be placed and eventually decides to include the bit of forested plain with the forested-mountain landscape.

A relatively simple solution of such a difficulty would consist of generalizing only one set of phenomena at a time and then comparing the patterns of distribution. Such, indeed, is the method used by Schott in his study of the Atlantic Ocean, except that he includes no comparison of the distribution relationships of the four regional schemes. If one basic system of regions is desired for the oceans to serve as a basis for the organization of the text, then it might well make use of the hydrologic facts. The failure of a system of climatic regions or biologic regions or others to coincide or even correspond with the hydrologic divisions could then be made the subject of analytic investigation. From such researches new and important relationships might be expected to emerge, whereas the attempt to synthesize such diverse things as hydrology, climate, and forms of life may only obscure these relationships.

The most satisfactory system of regions, too, would be so organized as to bring out the similarities between analogous regions in the different oceans. The divisions on Figure 1 do not accomplish this end with complete success. It appears to the

[5] Note R. C. Murphy's use of regional subdivision in his monograph on "Oceanic Birds of South America," 2 vols., New York, 1936. (Compare "A South American Circumnavigation," *Geogr. Rev.*, Vol. 26, 1936, pp. 489–495.)

[6] This new regional division was first announced in a review of Schott's work by W. L. G. Joerg: The Natural Regions of the World Ocean According to Schott, *Trans. Amer. Geophys. Union, Sixteenth Ann. Meeting, April 25 and 26, 1935*, Washington, 1935, Part 1, pp. 239–245.

[7] Gerhard Schott: Die Aufteilung der drei Ozeane in natürliche Regionen, *Petermanns Mitt.*, Vol. 82, 1936, pp. 165–170 and 218–222.

[8] Siegfried Passarge: Wesen, Aufgaben und Grenzen der Landschaftskunde, *Petermanns Mitt. Ergänzungsheft No. 209*, 1930, pp. 29–44.

reviewer that in the face of differences and similarities of about equal force Schott tends to separate on the basis of the differences rather than to unite on the basis of the similarities. For example, in the North Pacific he includes Bering Sea with the East Asiatic Marginal Seas (27), whereas in a similar position in the North Atlantic he extends Region 2 across to Labrador. Region 27 is unified on the basis of position behind an island fringe, a monsoonal circulation, a transition from marine to continental climate, and the existence throughout of cold, greenish water, rela-

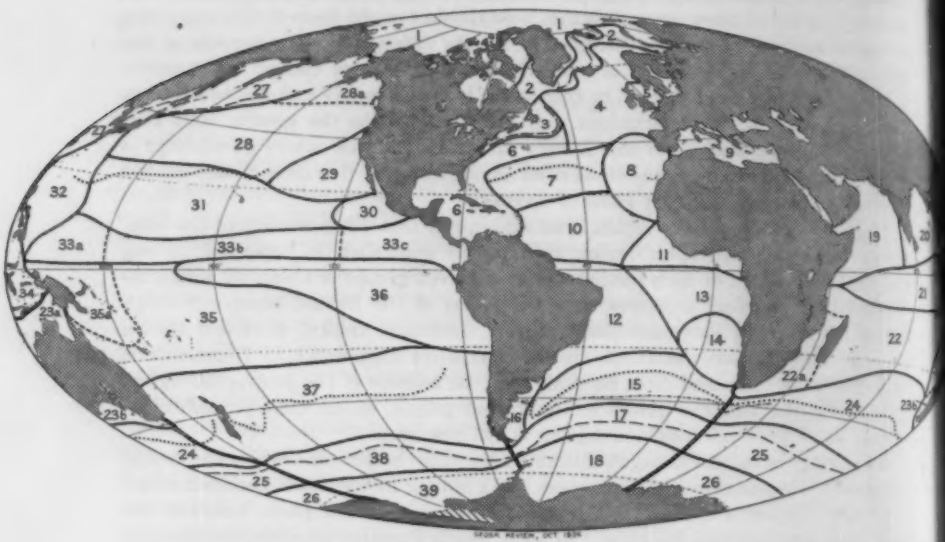

FIG. 1—The natural regions of the oceans. The map is drawn on a reduced scale (about one-third from Schott's map (see footnote 7). The regions are:

ATLANTIC OCEAN

1. North Polar Sea
2. North Atlantic Sub-Polar Region
3. Northwest Atlantic Marginal Sea
4. Northeast Atlantic Drift Region
5. North and Baltic Seas
6. Gulf Stream Region
7. Sargasso Sea
8. Morocco Region
9. Mediterranean and Black Seas
10. North Atlantic Trade Wind Region
11. Atlantic Equatorial Region
12. Brazilian Region
13. Ascension Region
14. Southwest African Region
15. South Atlantic Mid-Latitudes
16. Patagonian Region
17. South Atlantic Sub-Polar Region
18. Atlantic South Polar Region

INDIAN OCEAN

19. Arabian Sea, including Red Sea and Persian Gulf
20. Bay of Bengal
21. Indian Equatorial Region
22. Mauritius Region, including Mozambique Region
23. (a) Northwest and (b) Southwest Australian Region
24. South Indian Mid-Latitudes
25. Indian Sub-Polar Region
26. Indian South Polar Region

PACIFIC OCEAN

27. East Asiatic Marginal Seas
28. North Pacific Mid-Latitudes, including Alaskan Region
29. Californian Region
30. Mexican Region
31. North Pacific Trade Wind Region
32. Japanese Region
33. Pacific Equatorial Region
34. Malayan Region (Sunda Seas)
35. South Pacific Island Clusters
36. Galápagos Region
37. South Pacific Mid-Latitudes
38. South Pacific Sub-Polar Region
39. South Pacific South Polar Region

tively low in salt and rich in marine life. But a similar argument could be presented for Regions 2 and 3. To be sure, the North Atlantic receives a seasonal deluge of icebergs, whereas icebergs do not emerge into the North Pacific; and this provides a real basis for the different regional division of these two continental east coasts, if one is seeking such a basis. Again, Schott recognizes a Mexican Region (30), similar to the Californian Region (29) but characterized by seasonal storminess. Similar storminess does not occur in the Morocco Region (8). Yet it might seem that between these two parts of the world the general similarity of climate, ocean tem-

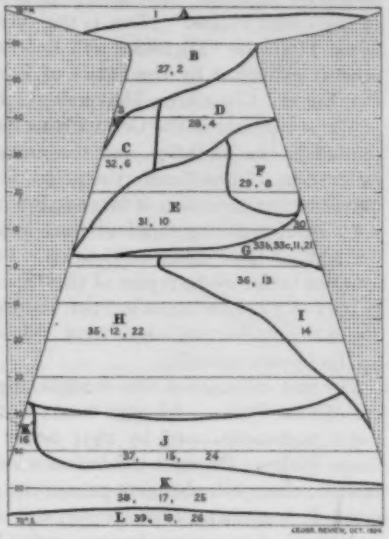

FIG. 2—Diagrammatic representation of the natural regions of the oceans. The regions are:

A. North Polar Region (1)
B. North Sub-Polar Region, with B′ Cold Water Subregion of the East Continental Marginal Seas of Higher Middle Latitudes (2, 3, 27)
C. Warm Water Region of the Continental East Coasts in Lower Middle Latitudes of the northern hemisphere (6 and 32)
D. Northern Middle Latitudes, with easterly drift, etc. (4 and 28)
E. Northern Low Latitudes, with westerly currents, etc. (10 and 31)
F. Cold Water Region of the Continental West Coasts in Higher Low Latitudes and Lower Middle Latitudes (8, 29, part of 30)
G. The Equatorial Region, easterly currents of warm water, etc. (11, 21, 33, part of 30)
H. Southern-hemisphere counterpart of E (12, 22, 35)
I. Southern-hemisphere counterpart of F (13, 14, 36)
J. Southern-hemisphere counterpart of D (15, 24, 37)
K. Southern-hemisphere counterpart of B: K′ counterpart of B′ (16, 17, 25, 38)
L. Southern-hemisphere counterpart of A (18, 26, 39)

perature, ocean color and salinity, and marine life would outweigh the differences in storminess when one is attempting to present a generalized world picture.

Another striking example of Schott's emphasis on the contrasts appears in his treatment of the cold-water regions of the continental west coasts in the southern hemisphere. The Galápagos Region (36) extends far out into the Pacific Ocean westward from the coast of South America. The analogous Benguela Current of the South Atlantic is divided into the Southwest African Region (14), corresponding to the southern part of the Galápagos Region, and the Ascension Region (13), differing in degree rather than kind from the western Galápagos Region.

On the basis of the material contained in Schott's volumes the reviewer has drawn up a suggested scheme for a more systematic regional division of the oceans. This has been prepared in diagrammatic form, similar to the well known generalized continents of Köppen. The generalized ocean (Fig. 2) is here represented as narrowest about latitude 60° N. and widening out to the south. The actual irregularities of the continental outlines account for most of the disagreements between the world pattern of regions on the map and this schematic counterpart. It would probably be desirable to revise the boundaries of Schott's regions to coincide uniformly with hydrologic facts, such as the surface currents and convergences.

On the diagram (Fig. 2) twelve regional divisions are recognized. The position of Schott's regions on the diagram is indicated by numbers (corresponding to the numbers on Fig. 1) except for these unique regions: the True Monsoon Regions (19, 20, 23, 33a, 34, 35a); the European Enclosed Seas (5, 9); Sargasso Sea (7); and Mozambique Region (22a).

GEOGRAPHICAL RECORD

NORTH AMERICA

Migration and Economic Opportunity in the Great Plains. "The history of the Great Plains has been marked by periods of over-expansion during years of heavier than average rainfall. Each was brought to a disastrous conclusion by one of the recurrent periods of drought. The forestalling of similar depressions in the future should be the major consideration in formulating a permanent plan for the settlement of the Great Plains." This is the theme of C. W. Thornthwaite's chapter on the Great Plains in "Migration and Economic Opportunity" (by Carter Goodrich and others) published by the Study of Population Redistribution (Wharton School of Finance and Commerce, University of Pennsylvania, 1936).

The settlement of the Great Plains began during a period of heavier-than-average rainfall in the seventies, and the drought of the nineties resulted in considerable emigration. Immediately thereafter followed the dry-farming boom and a consequent further extension of farming into the semiarid lands and rapid breaking of the sod. After 1920 the rapid advance in agricultural mechanization further increased the area of land under cultivation. For example, the land plowed in the twelve counties in the western part of the Texas High Plains increased from 1,424,000 acres in 1924 to 2,811,000 acres in 1929, and the value of machinery increased from $2,940,000 in 1920 to $11,968,000 in 1930. This boom was brought to a disastrous conclusion by the present drought.

The first evidence of this drought appeared in 1931 in three small desert areas in the central Plains. In 1933 desert conditions reappeared in the Texas and Oklahoma panhandles, and by 1934 desert conditions were prevalent throughout the Great Plains. Drought conditions continue to the present. There is no evidence that the climate is changing permanently, nor is the present drought without precedence. It is probable that the period from 1825 to 1865 was a long drought, interrupted only by occasional rainy years. In view of this it is possible that the present drought may last for several years more, and the occurrence of a single wet year is not to be regarded as the conclusion of the drought.

The distribution of rainfall is neither cyclic nor synchronous throughout the Great Plains, and as yet no satisfactory method of long-range forecasting of climate has been developed. For this reason Thornthwaite has approached the problem of permanent farm economy in the Great Plains from two angles—actuarial studies of the probable recurrence of climatic conditions and of the economic feasibility of crop production.

In developing an actuarial method of forecasting the probable occurrence of drought expectancy the author has utilized the concept of "climatic years" suggested by R. J. Russell (Climatic Years, *Geogr. Rev.*, Vol. 24, 1934, pp. 92–103) and has plotted on a series of maps the climates occurring in the Great Plains by year from 1910 through 1934, on the basis of precipitation effectiveness (see C. W. Thornthwaite: The Climates of North America According to a New Classification, *Geogr. Rev.*, Vol. 21, 1931, pp. 633–655; and the same: The Climates of the Earth, *ibid.*, Vol. 23, 1933, pp. 433–440). From these maps it is possible to determine for any locality the number of times that given climates have occurred in the past and the probability of their recurrence in the future. Three of the maps accompanying this note are summaries of the 24 maps of Thornthwaite's series and show the percentage of years when arid, semiarid, and dry subhumid climates have occurred during the 24-year period and may be expected to recur in the future. The fourth map, showing sharp climatic gradients, illustrates local variations in climate that may seriously affect farming prospects. It also is derived from the 24 climatic-year maps and shows zones in which rapid climatic changes occur within short distances. Farmers, un-

prepared for such rapid changes, tend to push across these narrow zones into areas where their agricultural techniques are destined to fail.

That sharp local contrasts in climate exist is commonly recognized by the farmers, but heretofore little scientific attention has been given to this problem. The "Field

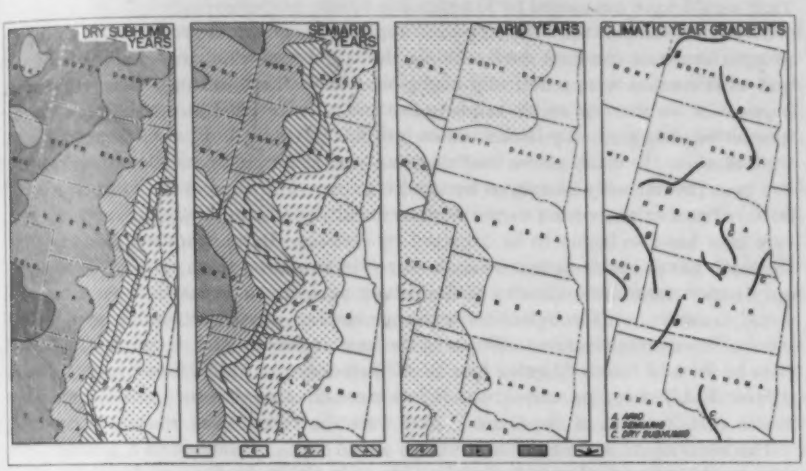

FIG. 1—Climatic maps of the Great Plains. The first three maps show percentage of occurrence of given types of climatic years in the period 1910 to 1934 inclusive: 1, 0; 2, under 20; 3, 20–39; 4, 40–59; 5, 60–79; 6, 80–99; 7, 100. The fourth map shows (8) lines along which climatic gradients are steep.

Studies in Climate" begun by the Soil Conservation Service may be mentioned in this connection. In three counties in central Oklahoma a close network consisting of 200 fully equipped weather stations, averaging one for every 12 square miles, has been established (in the country as a whole there is one station for every 1050 square miles, and in the Great Plains the number of stations is below the average). Observations are made hourly, and during rains the precipitation is noted at 15-minute intervals. This information is being plotted on maps and shows greater climatic detail than has ever before been possible for an area of comparable size. Of particular significance are the 15-minute-interval rainfall maps, which show in great detail the structure and movement of individual storms. To date, complete records for 8 months have been obtained concerning rainfall, temperature, wind direction and velocity, and humidity, and the results are sufficiently significant to warrant not only the continuation of the work but also its extension to other parts of the Great Plains.

In spite of droughts the occurrence of occasional good years tempts the wheat farmers in the Great Plains. "One is invariably told that if the price of wheat is high and there is adequate moisture and an abundant crop, the farmer will be able to pay for his land and machinery in a single season." This has undoubtedly been the case. In 1920 there was a bumper wheat crop, and prices were almost at their wartime high: the average net return from a 640-acre farm in Sheridan County, Kansas, was $20,472.32. But, the total income for the entire 21-year period from 1912 to 1934 amounted to only $21,167.36; hence the total income for 20 years was only $695.04, or an average of less than $35 a year, in return for the labor of the entire family. In more than half of the years there was an actual loss. It is doubtful whether any farmer could budget his income satisfactorily with so uneven a distribution. The recurrence of conditions such as those of 1920 is becoming increasingly less probable. Since 1920 the wheat acreage of the country has increased so much that in years of good yield the crop would be large enough to depress prices through-

out the country. Even if it were possible to stabilize prices, the variations in yield would result in enormous differences in the annual incomes. In Sheridan County, if the price of wheat had been stabilized at $1.00, the average income per acre for the period from 1912 to 1934 would have been $1.47, whereas the per-acre income of 1920 would have amounted to $15.56.

Even more serious than the economic implications of wheat production is the effect of agriculture on the land itself. While the original sod remained unbroken, runoff and wind erosion were practically negligible. With the breaking of the sod, erosion began first on the less stable sandy soils; and, as plowing has continued, even the heavier soil has gradually broken down into fine particles and has become subject to wind erosion. In many places land that has been under cultivation less than 15 years has been permanently destroyed by wind erosion. The number of livestock has not been reduced in proportion to the increase in cultivated land, and the overgrazed pasture land has also begun to be damaged by erosion. In no other semiarid region of the earth has so much surface been destroyed in so short a time. However, throughout history there are evidences of flourishing agricultural areas that have been reduced to desert, not through climatic change but because of destructive wind erosion induced by overcultivation. This was the case in North Africa, North China, and even in parts of South America (see W. C. Lowdermilk: Man-Made Deserts, *Pacific Affairs*, Vol. 8, 1935, pp. 409–419). It is not conceivable that man could continue to live in certain parts of the Great Plains were the recent dust storms to continue.

The ideal situation in the Great Plains would be the reversion to a grazing economy combined with the raising of feed crops in the more favored localities. This would mean a drastic reduction in population, amounting to about 900,000 people. However, Thornthwaite estimates that a "minimum reduction from the 1930 population consistent with a safe use of the land would be about 390,000 people." School-census records indicate that about 150,000 people moved out from the Great Plains of their own accord between 1930 and 1935, so that the surplus population is about 240,000. This figure is not a definite forecast. If government subsidy in the form of relief or crop loans continues, the population may remain but there seems to be no economically sound and self-liquidating method by which this surplus can be absorbed within the limits of the Great Plains.

As alternatives to emigration, irrigation, the equalization of holdings, and subsistence homesteads have been suggested. However, farmers now on relief are in no position to invest in expensive irrigation works. Of the plowable pasture of the Plains States, about 55 per cent is in cash grain farms and is not available for distribution. Only in Wyoming are there still enough areas in large ranches to take care of the surplus population, and any subdivision of these would involve the disrupting of the present economic regime. The fact that the minimum practical size of farms in the Great Plains is 640 acres indicates the impracticability of establishing small subsistence homesteads within the area. From this it is apparent that "until it is possible to accomplish considerable retrenchment there are only two alternatives for the Great Plains—either permanent poverty and distress or permanent subsidy."

LOIS OLSON

Ethnic-Group Colonization in Western Canada. It is usual to speak of the pioneer in North America as an individualist and of our pioneer colonization as resulting in the throwing up of amorphous communities of these diverse and unrelated individuals. Perhaps this obvious characteristic of our growth has been overstressed, while not enough has been made of the virtual transplanting in many instances of parts of whole communities en bloc whether from New England or the Carolinas or from the Old World.

However that may be, there have been many examples of ethnic colonization, in

the strictest sense, in the history of American expansion. Of these the various religious communities—early villages of Mennonites, Dunkers, Moravians, Schwenkfeldians; Shaker towns; such experiments as those at Economy, Zoar, and Amana; the Mormon exodus to the Far West; the more recent communistic villages of Hutterites in the Dakotas—offer the purest examples.

Colonization of the Prairie Provinces of Canada (Manitoba, Saskatchewan, and Alberta) is a latter-day, almost wholly twentieth-century phase of American pioneering, which repeats in modern terms an old and familiar pattern. As the seventh volume of the *Canadian Frontiers of Settlement* series under the editorship of W. A. Mackintosh and W. L. G. Joerg (cf. H. A. Innis: Canadian Frontiers of Settlement: A Review, *Geogr. Rev.*, Vol. 25, 1935, pp. 92–106) Professor C. A. Dawson has contributed a study of five ethnic groups of "peculiar peoples" as they have functioned and are functioning on the Canadian pioneer fringe (Group Settlement: Ethnic Communities in Western Canada, Toronto, 1936).

The Dukhobors (spirit wrestlers), whose lot in Russia aroused the sympathy of Tolstoy, have established colonies that have become a fixture on the prairie landscape. Their partial communism, vegetarianism, general policies of isolation, nonintercourse, and self-sufficiency, their pacifism and religious fanaticism have offered peculiar problems and resulted in peculiar adjustments and compromises. The Menonnites, descendants of old Anabaptist followers of Menno Simons, with four hundred years of history and tradition, are pacifists who, in the pure state, seek only shelter and isolation. Some two hundred years ago the sect furnished Pennsylvania with the bulk of its Pennsylvania "Dutch." The Canadian Mennonites come from those members of the sect who, on the invitation of Catherine the Great, left Germany for Russia and became a fixture there while retaining their Germanic speech and customs. A rigorous and ruthless policy of Russianization undertaken by the Czar in 1870 resulted in the migration of 1400 families of Mennonites to Canada by 1879. Difficulties arising largely out of the World War led a number of the "Old Colonists" to migrate again—to Mexico and elsewhere. But as with all other sects, modern life has worked considerable havoc with their fundamentalism and is making increasing inroads on their ethnic purity.

The Mormon colonies in western Canada date from 1887, after the church had made its peace with the United States government by renouncing polygamy in practice. Persecution of leading Mormons already entangled in plural marriages, with wives and children to provide for while the threat of prison hung over their heads, drove many of them across the border. The German Catholic colonies, bloc settlements, at St. Peter's and St. Joseph's in Saskatchewan and the areas dominated by French-Canadian groups offer also an unusual field for study of ethnic-group pioneering. These scattered "cultural islands," striving to maintain the purity of their "way of life" against the encroachments of organized forces such as government, schools, railroads, and capitalism and the interpenetration of modern New World social influences, have raised many problems—notably in the case of the Dukhobors. But the tendency is rapidly toward coöperation with the body social accompanied by considerable amalgamation.

The human element in the "ecological adaptation of human communities to their environment" and "the need to recognize the variety of conditions and of human material" with its inherited skills and traditions, which "cannot be generalized into neat cadres," are stressed by Robert England in his "The Colonization of Western Canada: A Study of Contemporary Land Settlement (1896–1934)" (P. S. King & Son, London, 1936). Field records and statistical analyses support the importance of this factor in relation to the geological, geographical, political, and religious factors of agricultural western Canada. Mr. England examines Slavic, German, Dutch, Scandinavian, Hungarian, British, and French communities of the northwest country as well as the same religious communities that are the subject of Professor Dawson's work.

A point made in both volumes is that economic stability and standard of living cannot be gauged by cash turnover or trade statistics. Many of the ethnic-group communities seem to fall below the economic standard of the whole. But examination into their "way of life" shows in many instances, particularly during the years of depression, a real balance in their favor. The one-crop agricultural speculator makes money in good times, but, as experience in the United States has shown, he has little security. With their more self-sufficient economy, their prime demand for subsistence first, their internal discipline, these group settlements have something to teach the prairie farmer.

FRED T. MARSH

The Amana Community. Shortly before the middle of last century the Amana sect migrated from Germany to the United States. After a temporary settlement near Buffalo the migrants took up a tract of 18,000 acres in the Iowa River valley and here the Amana Society was incorporated in 1859. Organization was on a communal basis; the members had no real or personal property; the seven villages in which they were grouped had a certain degree of autonomy; the community as a whole was virtually self supporting. The selection of the society's land in good farming country of varied resources and the placement of the individual villages would seem to reflect excellent judgment on the part of the founders. The society proved unusually successful and maintained its status until 1932, when it was reorganized as a stock company. Increasing pressure on the isolation that had been the strength of the religious organization made continuance of the society economically impossible. This change in the fortunes of Amana is the subject of an article by Darrell H. Davis, "Amana: a Study of Occupance," in the July number of *Economic Geography* (pp. 217–230; see also B. M. H. Shambaugh: Amana—In Transition, *The Palimpsest*, Vol. 17, 1936, pp. 149–184).

Present day Amana occupies some 26,000 acres and has a population of 1461. The size, layout, and character of the agricultural land are such as to make for economy in operation and the area is well situated as regards transportation. As an experiment in corporate farming it is well worth watching. One immediate response to the relinquishment of church control was the introduction of the automobile, heretofore forbidden: the community now owns 144 private cars. The economic changes have not yet materially altered the physiognomy of the settlement. The villages, embowered in gardens and orchards and conspicuously lacking in "business centers" (shops are mainly in residences) present an unusual effect of quiet and restfulness.

Two Different Types of Industrial City in Pennsylvania. Fundamental differences between two industrial cities in Pennsylvania are brought out in recent studies of Johnstown and York by R. E. Murphy (The Geography of Johnstown, Pennsylvania, *Pennsylvania State College, Mineral Industries Exper. Sta. Bull. 13*, State College, 1934; The Economic Geography of York, Pennsylvania, *ibid., Bull. 17*, 1935; Johnstown and York: A Comparative Study of Two Industrial Cities, *Annals Assn. of Amer. Geogrs.*, Vol. 25, 1935, pp. 175–196). Johnstown, with a population of 100,000, lies in the Appalachian Plateau in a valley leading west some sixty miles to Pittsburgh. To the east is the abrupt east edge of the plateau, and beyond that are the folded mountains of central Pennsylvania. York, with a population of 70,000, faces toward Philadelphia and Baltimore. It is in the Pennsylvania Piedmont at the west edge of the populous eastern seaboard country. Johnstown is in a region rich in bituminous-coal resources but of indifferent agricultural quality; York and its vicinity lack great fuel resources but balance against this deficiency the better agricultural quality of southeastern Pennsylvania. Johnstown's development has been the result of its mineral deposits; York's growth has been the result of a good location and unusually good labor conditions. Johnstown's industries have to do primarily with the processing of raw materials, York's with the finishing of processed material.

The patterns of the two cities are entirely different. York, lying on a level-floored lowland, is much more regular and compact than Johnstown. It reflects the influence of its colonial planners: its plan is English in frame, but the city was settled largely by Germans. Architecturally there is a striking uniformity not found in Johnstown—long rows of red-brick houses under a single continuous roof. Located at the junction of Stony Creek and the Little Conemaugh River, Johnstown is predominantly a river-valley city, restricted by the valley walls. Crowded lowland sections and elongation along the valley floor have thus resulted. The steep valley sides have been left unused (55 per cent of the area of the geographic city is wasteland), and a second level of the city has developed on the plateau surface above that is connected in only a few spots with the town of the valley floor.

The total area of York is only about half that of Johnstown. York, with only 8 per cent of its area devoted to manufacturing, has 22 per cent of its population engaged in that industry; Johnstown has 10 per cent of its area and 11 per cent of its population engaged in manufacturing. Johnstown is dominated by one industry, the manufacturing of iron and steel, and one concern employs about two-thirds of the city's manufacturing wage earners. York's industries are largely diversified, the largest company employing 12 per cent and the second largest 4 per cent of those engaged in manufacturing industries. Johnstown felt the depression severely and York only to a slight degree.

SOUTH AMERICA

The Soil Geography of South America. The actual field mapping of the world's soils will be a slow and laborious process. Before the detailed maps are available there may be some advantage in the preparation of hypothetical maps based on a few scattered reconnaissance observations and extended on the basis of supposed relations between soil on the one hand and geognosy, climate, and vegetation on the other; but the tentative nature of their soil boundaries and soil categories should not be forgotten. The attempt to produce a map of the soils of South America, even by the leading authority on this subject, meets with peculiar difficulty (Adolfo Matthei: Die Bodengeographie von Südamerika, *Soil Research*, Vol. 5, 1936, pp. 75–98). Only a relatively small proportion of South America is level land; much of its surface is hilly or mountainous, and in such lands the general relationships of soil and climate are obscured by dominant and varied edaphic conditions. Matthei's map extends his soil divisions confidently and with deceptive detail over regions that are as yet little explored and in which the patterns of vegetation and climate have yet to be established.

In his text, which discusses only Argentina, Brazil, and Chile, one or two negative remarks are of great importance at this time. In the first place, Matthei points out that the black soils of the Argentine Pampa, which some writers have assumed to be related to the chernozems, have not yet been studied carefully enough to prove their relationship to this group of soils. This is a part of the world in which the need for a detailed soil investigation carried out by qualified workers is imperative, and, in advance of this, the preparation of maps based on assumed relationships should be discouraged. Matthei states further that the red soils of Brazil should not be mistaken for laterites. Laterites show a basic reaction and are poor in humus and rich in iron. The Brazilian red soils, on the contrary, have less than 20 per cent of Fe_2O_3 and FeO, show a neutral or acid reaction, and are relatively rich in humus. The color is due, chiefly, to the parent material. Matthei includes on his map a small patch of laterite in the middle São Francisco Valley but does not mention it in his text. One is left with the awareness of the almost complete lack of reliable information regarding the soils of South America and with the wish that an invasion of that continent by soil specialists might take place soon.

PRESTON E. JAMES

Natural Regions of São Paulo. "Man, more than nature, endows the face of the earth with those individual peculiarities of landscape that produce an awareness of the personality of regions." This is the theme that Pierre Deffontaines develops in a beautifully composed regional sketch of the state of São Paulo—a sketch that may well stand as a model of that kind of geographical writing (Pays et paysages de l'état de Saint-Paul (Brésil): Première esquisse de division régionale, *Ann. de Géogr.*, Vol. 45, 1936, pp. 50–71 and 160–174). But man has not yet established himself firmly enough on the Brazilian scene, even in São Paulo, to recognize the individuality of small areas. So far the Brazilians are chiefly aware of the contrast between settled country and the *sertão*, the unsettled wilderness of the vast interior. As is perhaps characteristic of Occidental pioneer areas, the territory is arbitrarily divided into zones corresponding to the various railroad tentacles along which settlement is progressing.

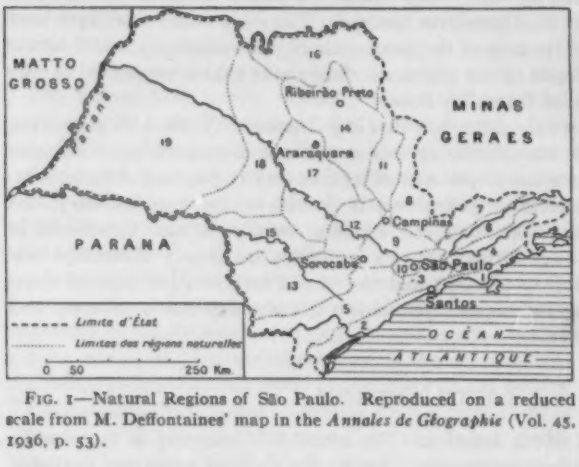

FIG. 1—Natural Regions of São Paulo. Reproduced on a reduced scale from M. Deffontaines' map in the *Annales de Géographie* (Vol. 45, 1936, p. 53).

M. Deffontaines divides the state of São Paulo into 19 embryonic regions (Fig. 1). Regions 1 and 2 occupy the narrow coastal zone backed by the sharply defined escarpment known as the Serra do Mar. Region 1 lies east of Santos where the mountains rise directly from the sea. No large rivers enter the sea along this coast, and, as a result of the absence of alluvium, with which the shore currents might regularize the indentations, the shore line is one of extreme youth. A fairly dense population engages chiefly in fishing. The other coastal region extends west of Santos. Here the Rio Itanhaem and the Ribeirão de Iguape have cut well back into the plateau and bring to the shore sufficient alluvium for the construction of a long bar with few openings. In this region is found the thriving Japanese colony at Registro, with its emphasis on rice culture. Recently there has been a considerable increase in the area devoted to banana plantations.

Regions 3, 4, and 5 include the mountainous edge of the plateau. The first of these lies between Santos and São Paulo where the crystalline peneplain reaches the top of the coastal escarpment in a condition only slightly modified since the uplift. On each side, regions 4 and 5 include areas where the streams have cut deeply into the uplifted surface, so that a mountainous terrain difficult to cross or to occupy has been created (see P. E. James: The Surface Configuration of Southeastern Brazil, *Annals Assn. of Amer. Geogrs.*, Vol. 23, 1933, pp. 165–193; and the map in the *Geogr. Rev.*, Vol. 22, 1932, p. 232). The concentration of the routes to the plateau in the zone of region 3 has led to the rise of Santos and São Paulo. In previous times, however, region 4 was crossed at several places by roads connecting the towns of the Parahyba Valley with the small ports in region 1. Only after the coming of the railroads and the decline of mule transportation were these shorter routes abandoned in favor of the easier route.

Region 6 is the Parahyba Valley, the oldest area of settlement in the state. This region has witnessed the rise and decline of successive fazendas, first of cotton, then of sugar, then of coffee. At the present time dairy products for the market at Rio de

Janeiro, rice cultivation in the river flood plain, and the establishment of varied manufacturing industries in the towns are combining to lift this region from the decadence into which it fell with the decline of coffee. Regions 7, 8, 9, and 10 include the crystalline mountains and the São Paulo basin. The first three of these are old coffee regions, in a state of decadence, like the Parahyba Valley. The beginnings of recreational development and renewed interest in dairying, as well as the rapid urban development in region 10, are the tendencies in the direction of growth.

Regions 11, 12, and 13 are in the Permian depression—an "inner lowland" on weak rocks lying between the crystalline oldland on the east and the series of prominent cuestas on the west. This is a zone, it seems, of poor soils and rather extreme temperatures. Largely neglected by the coffee producers, the tree-dotted savanas that covered this region were utilized extensively for cattle pastures. At the present time there is a distinct movement from the more densely populated crystalline lands into the Permian depression, where small landholdings are being established for the production of manioc, maize, cotton, sugar, and oranges and other tropical fruits. The middle part of this depression, region 12, is especially prominent as an area of mixed farming on small landholdings. In the vicinity of Sorocaba is concentrated the rapidly increasing cotton acreage of the state.

West of the Permian depression are the Botucatú cuesta and the patches of *terra roxa* that previously supported islands of luxuriant forest and that are now mostly covered with coffee plantations. Regions 14 and 15 are the chief coffee-producing areas. As region 15 is exposed to the dangers of winter frost, the regime of cultivation and harvesting is somewhat different there from that in the vicinity of Ribeirão Preto. Region 16 lies north of the coffee lands where the rainfall is not enough for that crop. In this region, however, are some of the fine pastures of native grasses on which cattle brought from the interior are fattened for market. The centers of this cattle industry are at Franca and, especially, Barretos. Region 17, centering on Araraquara, lacks the *terra roxa* and also the large coffee fazendas. It has been entered recently by a large number of small landowners practicing a mixed farming similar to that of the neighboring parts of the Permian depression.

Finally, region 18 is the pioneer fringe, and 19 the largely untouched wilderness beyond. Until the coffee crisis of 1928 the large estates were leading the westward march of the frontier, but at the present time to a greater and greater extent small landowners occupying their own farms are the ones actively pushing the area of settlement toward the west. Rice, beans, and wheat, along with coffee, are the crops of this pioneer land.

Mixed farming, together with small landholdings and a peasant population, seems definitely on the increase, especially in regions 11, 12, 13, 17, and 18. Beyond lies the *sertão*, still largely unoccupied. Yet so rapid is the progress of settlement in the state that, as one watches, new regional entities emerge to differentiate the monotonous landscapes of the wilderness.

PRESTON E. JAMES

Land Settlement in Brazil. The problem of settlement in Brazil is treated in a recent paper by R. Paula Lopes (Land Settlement in Brazil, *Internatl. Labour Rev.*, Vol. 33, 1936, pp. 152–184). The present policy of the state and federal governments, which has been in force since 1882, is to "populate the land and ensure its cultivation" and, as secondary objectives, "to retain the immigrants permanently in the country and break up the big estates." Unfortunately, about 48 per cent of the immigrants into the state of São Paulo returned later to their own countries. Unfortunately, also, for the process of settlement, not all the immigrants who remained in Brazil turned to agriculture. Of the Italian and Portuguese immigrants only about half are agriculturists; the Spanish immigrants show a higher proportion, 81.4 per cent; and the Japanese are almost wholly in the agricultural group, 98 per cent.

In many parts of Brazil colonies, under both public and private control, have been

established. With one exception, however, effort was concentrated on the acquisition of land and the attraction of settlers. No technical advice was provided to guide the immigrant in the clearing of the forest or in the proper methods of handling the unfamiliar crops. The geographical inventory and the planning of land use have been unknown—with one exception: the Japanese colonies were all carefully studied and laid out before the arrival of the first settler.

The problems of land settlement in the three southern states, Rio Grande do Sul, Santa Catharina, and Paraná, are different from those in the region of the large coffee estates. When the first immigrants landed in Rio Grande do Sul in about 1824, opportunities to acquire land and establish permanent homes were opened to them; for this southern region was not suited to the raising of either sugar or coffee, on the basis of which the planting aristocracy farther north was enriching itself. The absentee owners of the cattle ranges of the south were only too glad to avail themselves of the opportunity to convert their relatively unproductive land into cash. In the course of three or four generations the population of Rio Grande do Sul and Santa Catharina has trebled, largely from natural increase. This is the zone of the widely heralded German colonization; but, in spite of the prevailing impression, the German ingredient has not remained undiluted. In an estimated population of 951,000 in 1929 the state of Santa Catharina included some 206,000 persons of German origin. Among these only the more isolated groups have failed to adopt the Portuguese language or in some measure to become "Brazilianized."

The process of settlement in the state of São Paulo has followed different lines. By the middle of the last century coffee had eclipsed all the competing phases of land use, and its urgent need of labor not only absorbed the increasing stream of immigrants but even drew from their holdings many of the previously established small owners. Unfortunately, however, there was nothing permanent about the settlement of the coffee lands. The desire to develop a permanent settlement of the agricultural territory of São Paulo leads directly to the problem of the breakup of the large holdings. Three economic trends seem to be leading to this desired end. In the first place, in recent years it has become definitely more profitable to sell an estate in small parcels than to sell it as a unit. In the second place, capital is being transferred to the growing industrial structure of the state. The capital invested in manufacturing establishments in the state of São Paulo rose from 535,800 contos in 1920 to 1,534,000 contos in 1933, much of this investment having been removed from the production of coffee. In the third place, there is the increasing prosperity of the tenant workers. Largely as a result of government intervention, the average immigrant whose family is employed on a large estate can now save enough within a few years to buy himself a piece of land.

These changes in the economic environment will of necessity lead to far-reaching transformations of the Brazilian scene—perhaps eventually to the construction of an adequate base of settlement from which to begin the conquest of the interior.

PRESTON E. JAMES

EUROPE

Agriculture and Land Reclamation in Italy. The new "Atlante agricolo dell'Italia fascista" by Arturo Marescalchi and Luigi Visintin (Istituto Geografico De Agostini, Novara, [1935?]) is a useful volume of handy size containing 92 neatly printed and attractively colored maps and many graphs. Most of the maps show field and tree crops and animal products in terms of areas and of yields to a hectare. There are also maps showing the distribution of farm population, rural housing conditions, reclamation projects, irrigation, and the use of fertilizers. The "dot" method of mapping distributions, used extensively in the publications of the U. S. Department of Agriculture (including the "Atlas of American Agriculture"), is not employed on any of the maps in this Italian publication. Distributions are shown by provinces by means

of graded tints of color. On some of the maps transparent "pie" diagrams show percentage distributions by *compartimenti* (units comprising several provinces), and the result is less confusing than one might expect would be the case. The maps and accompanying diagrams, for instance, bring out clearly the importance of wheat in Italian agricultural economy.

Special mention may be made of the land-reclamation map on a scale of 1 : 3,250,000, showing works under consideration, in course of construction, and completed. No less than 240 projects are shown and identified by number: a following table names them and gives the area of each and the totals by *compartimenti*.

"Land-Reclamation in Italy" by Cesare Longobardi (P. S. King and Son, London, 1936) treats of legislative and economic aspects of the *bonifica integrale*. One topic discussed is the relation of reclamation to the wheat campaign as a result of which the yield has been greatly increased, wheat importations have been reduced, and the unfavorable balance of trade has been improved. In the five-year period 1920–1921 to 1924–1925 net wheat importation amounted to more than 2½ million metric tons; in 1934, to only 235,700 metric tons. Typical reclamation schemes are described in some detail—those of the Pontine Marshes (cf. R. S. Frost: The Reclamation of the Pontine Marshes, *Geogr. Rev.*, Vol. 24, 1934, pp. 584–595), the lower Piave, the Brisighella, the Sele, the Tirso. The Brisighella project is "a special form of hydro-agrarian reconditioning of mountain lands, in the lower Apennines with a Pliocenic clay soil." These are areas peculiarly liable to landslides, and special measures are needed against erosion. The Sele project embraces flood control and irrigation of the fertile plain about the Gulf of Salerno. The Tirso project is concerned with extension of the irrigation facilities afforded by Sardinia's great artificial lake (cf. Marcello Vinelli: Water Conservation in Sardinia, *Geogr. Rev.* Vol. 16, 1926, pp. 395–402).

The Geography of Sardinia. The kingdom of Italy is not everywhere overpopulated. In Sardinia the contrary would appear to be the case. "Today as in the past," writes Dr. Gavino Alivia of Sassari, " 'the Sardinian problem' presents itself in the lack of a population adequate to the territory—to its resources and to the length of its shore line." Dr. Alivia seeks to explain the island's retarded development in terms of isolation, uncertain rainfall during the growing season, the blighting effects of the long period of Spanish rule, and, until recently, a laissez-faire policy on the part of the government. The isolation due to Sardinia's insular position has been increased by the fact that the more densely populated areas (except for the largest towns) are nearly all in the interior. Dr. Alivia believes that malaria is less a cause than a consequence of social and economic backwardness.

In 1887–1889 the death rate from malaria was 298.2 to a thousand deaths; by 1920–1922 this figure had been reduced to 108.0 and by 1928–1930 to 59.4 (as contrasted with 6.9 for the kingdom). Despite this notable progress Sardinia has the highest malarial death rate in Italy and is still one of the most malarial regions of Europe. Professor L. F. de Magistris of Milan believes that the island might support twice its present population if the scourge could be eradicated. As an aid to this end he advocates the preparation of a malaria map of the island based on truly geographical, rather than on merely statistical, criteria.

The papers from which these data are derived were presented before the Twelfth Italian Geographical Congress, held in Sardinia in the spring of 1934. As nearly all the communications dealt with Sardinia, the published transactions form a contribution of the first importance to the somewhat meager geographical literature of the island. Although several of the papers have to do with matters of detail or with small areas, most of them are in the nature of résumés of the status of present knowledge concerning broad subjects: geology, geomorphology, the geography of plants and animals, climatology, mineral resources, springs, runoff, and various economic and historical questions. Much attention is devoted to the description and dis-

cussion of the elaborate program of public works being undertaken by the Fascist regime, involving the construction of reservoirs, drainage and irrigation projects, malaria control, and the settlement of hitherto undeveloped areas, particularly in the lowlands. The volume of transactions (*Atti XII Congr. Geogr. Italiano*, Consiglio Nazionale delle Ricerche Comitato per la Geografia, Cagliari, 1935) is accompanied by a folder containing many interesting distribution maps, an excellent hypsometric map covering Sardinia, Corsica, and Elba (1 : 500,000), and striking diagrams illustrating the physiographic relationships of Sardinia and Corsica.

The Olive Industry of Spain. Last season about 48 per cent of the world's crop of olives was produced in Spain. This, although a little more than the average, indicates the importance of Spain in the production of olives (M. Costa: Olives in 1935–36, *Internatl. Rev. of Agric.*, Vol. 27, 1936, pp. 28S–31S). More than half of the wealth in olive trees is found in Andalusia, and the greatest number of trees are in Jaén, Córdoba, and Seville (A. Pascual: Olive-Growing in Various Countries: (1) Spain, *ibid.*, Vol. 25, 1934, pp. 536T–543T). A line drawn from the southwest tip of Salamanca to the southeast tip of Soria and from this point directly north would divide fairly well the olive-producing areas of the south and east from the non-olive-producing area of the northwest. Few trees respond as readily as the olive to climatic and soil conditions. The region of greatest concentration includes the Andalusian lowland, where about half of the rural population are dependent on the industry for a livelihood, and a considerable amount of the slopes of the Sierra Morena to the north and the Sierra Nevada to the south. The southwestern coastal plain is excluded because of swamps. The southern littoral is in general unfavorable climatically. Almost all of the northeastern maritime zone is well suited to olive culture. The south-central plateau is broken up by several mountain chains, which so diversify the climate that it is impossible to give a clear generalization for a very large region. Warm temperatures, absence of severe frost, low humidity, and favorable winds are the four fundamental climatic conditions for olive culture. The tree is intolerant of excessive humidity; heavy rains hinder the development of flowers, and continued dampness usually results in diseases. It is equally sensitive to winds; too strong winds "fatigue" it—retard its growth and distort it. Almost all the most productive regions are in areas where the precipitation is less than 20 inches. Within the same locality variations in slope and the direction it faces and in altitude may have a marked influence on the maturing period, quantity of oil, and health of the tree. The olive trees of the Andalusian lowland are grown in alluvial soils, sandy clays, and calcareous marls, all high in lime and rich in organic matter. Insects, diseases, fungi, and lichens plague the olive, and all Spanish orchards are infested with one or another. The losses caused by the olive fly alone represent about 5 per cent of the value of the average oil yield. The finest oils come from the northern olive regions: those from Tortosa are the most famous. Until recently Italy was the largest importer of oil from Spain, the United States second, Argentina and Cuba next. The Italian market, however, is in danger, since Greek exports to Italy quadrupled during the period 1930–1932. "This tremendous increase, coupled with the decrease in Italian markets, practically squeezed Spain out of Italy." The Spanish olive industry is today at a critical period. The future success of the industry seems to depend largely on the establishment of favorable trade agreements and on the organization of the growers and the exporters. The National Association of Olive Growers has done a great deal but as yet has not enough members to give it strength politically (W. E. Bull: The Olive Industry of Spain, *Econ. Geogr.*, Vol. 12, 1936, pp. 136–154). A trend in this direction is indicated by rules for the production of oil laid down by the state and national and regional organizations. Harvest, transport, and packing of olives have been regulated, and the construction of mills has been encouraged. Decrees have been issued

forbidding oil other than olive oil to be sold as a food oil; a large field of competition in the home market is thus eliminated (Pascual, *op. cit.* Additional studies of the olive industry in Italy, Greece and Turkey, Tunis, Algeria, and Morocco, and Portugal and France were published in the *Internatl. Rev. of Agric.* for January, March, April, and July, 1935).

The Ebro Delta: A Pioneer Area in Catalonia. The Ebro Delta is unique in Catalonia, and culturally it may be considered a recent offshoot of the Ribera del Júcar in Valencia. This is the conclusion of E. H. G. Dobby after a field study reported in the *Geographical Journal* (The Ebro Delta, *Geogr. Journ.*, Vol. 87, 1936, pp. 455–469; unfortunately no map accompanies this excellent account). Only a few decades ago the delta was a wilderness of salt marshes: now two-thirds of it is under cultivation; it produces nearly a fourth of the Spanish rice crop and supports some 10,000 people. Like many other pioneer areas, the delta depends on a single commercial product, the *huerta* crops being destined for local consumption. New brick houses testify to the recency of settlement, and many temporary shelters of rice straw and wicker remain from the days when the early settlers went out daily in carts to work in their rice fields but lived on the higher land at the edge of the delta. The agricultural development of the delta has taken place mainly since 1914, when water was turned into the irrigation canal on the left of the Ebro. The influx of settlers was rapid; for rice culture brought attractive profits during the war years, when the flow of Oriental rice to European markets was cut off.

Both physically and culturally the area of recent alluvium contrasts sharply with the adjacent older land. The surface is so flat that the eye can detect no irregularities, and it is marked off in geometric design by rows of poplars planted to strengthen the banks of the canals. Construction is active. Since 1900 a band 50 meters wide has been added along the shore and the Ebro levees have been built up about 50 centimeters. The floods, which occur nearly every year, are building up the general surface at a much slower rate. The average elevation is only about one meter above average sea level, but very slight differences are reflected in the cultural patterns. The cultivated land is separated from the sea by an untilled strip where reeds and coarse grasses furnish pasturage for goats and a few cows. Rice fields totaling 14,000 hectares cover wide areas that are flooded only periodically. The Ebro levees and a strip of alluvial land adjacent to the older land are devoted to *huerta* crops, totaling 2000 hectares. Habitations, with associated *huertas*, occupy marginal or central locations, but there are a few scattered dwellings near Amposta. In the marginal settlements the houses occupy sites on the cliffs, well above flood level, and the *huerta* crops on the alluvial land below are irrigated from wells. The central population nucleuses stand upon the Ebro levees, many of the houses built on a raised platform about a meter above the surface. Each house is surrounded by a tract of *huerta* land, which is irrigated direct from the river and not from the main canals. Some abandoned *huerta* land, particularly in the western part of the delta, bespeaks soil injury due to irrigation. Land irrigated from wells has been injured most.

Present conditions make the future of the Ebro Delta seem precarious. Most of the alluvial area is unfit for any crop except rice. Winter cropping or rotation being unfeasible on the rice lands, work is highly seasonal, and soil fertility is maintained through the use of commercial fertilizers, mostly imported. Many additional laborers are needed during the transplanting and harvest seasons. Some men are drawn from the adjacent olive-growing area, but a larger number, estimated at 3000, come twice annually from the Valencia rice fields, where the seasons are two or three weeks earlier. The dependence of the Ebro Delta on a single export commodity makes it extremely sensitive to price changes; and owing to its high production costs it is poorly equipped to compete with Oriental rice exporters. The difficulty is aggravated by the preferential treatment given Empire products in British markets, which

formerly absorbed most of Spain's export rice. In domestic trade the Ebro crop is handicapped by the fact that it moves to market some three weeks later than the far larger Valencia crop. Developed under the abnormal trade conditions of the war years and unable to shift to other crops, the Ebro Delta presents one of the unsolved economic problems of the postwar period.

ALICE FOSTER

The Population of Austria. The results of a population census of Austria taken on March 22, 1934, are analyzed and compared with earlier figures in a recent study by Richard Marek (Einige geographische Ergebnisse der neuen Volkszählung in Österreich, *Geogr. Zeitschr.*, Vol. 42, 1936, pp. 98–105). Austria, with a population of 6,762,687, ranks fifteenth among European states. Only about half of the Germans in the old Austrian monarchy were included within the boundaries marked off by the Treaty of St. Germain. The population of the present area of Austria has increased by about one-half since 1869, but the rate of increase has been lessening of late. The average annual increase between 1923 and 1934 was only 0.31 per cent; and that there was any increase at all may be accounted for by an excess of births over deaths in the provinces. The population of Vienna was almost stationary during the period, a considerable excess of deaths over births in the city being counterbalanced by immigration. Throughout the country, moreover, the rate of natural increase has fallen off so rapidly since 1923 that today Austria as a whole has also reached a condition of essentially stationary population.

The Austrians have a catchword that likens Vienna to a hydrocephalic head, far too large for its body (*vom Wasserkopf Wien*). The capital, with 1,861,856 inhabitants in 1934, housed 27.7 per cent of all the people in the Republic. Only a little more than half of those who dwell in Vienna are true Viennese; about a quarter come from regions now outside the boundaries of the nation. In Austria there were 270,543 foreigners in 1934—mostly German-speaking—among them 18,762 *Staatenloser* or people without a country, whose fate "is in the main a sad outcome of the dissolution of the Danubian states." The facts disclosed by Professor Marek's paper are fundamental to an understanding of the economic and political situation in which Austria finds herself today.

London as an Industrial City. Why London came into being, the way in which it has grown, and the integration of the parts into a working unit are the themes of a small but comprehensive and entertaining book by J. F. P. Thornhill entitled "Greater London" (Christophers, London, 1935). Whether or not London had its beginning as the port of Verulamium (the modern St. Albans) and the grain-producing region of the southeast, it is certain that the city from its early days has been a market and, furthermore, a market with an international trade. It is out of this commercial function that London has developed industrially to become not only the greatest market but the greatest industrial city of Britain. "In 1930 there were about two and a quarter millions of insured workers in Greater London, and about a million and a half of these were employed in the production of goods." Because industry has been an outgrowth of population rather than of local raw material, London has escaped a certain tyranny; its "industries are its servants, not its masters." The growth of London's industries is in part a measure of the expansion of the city itself. These are the port industries, a belt of heavy industries around the docks and along the riverside and the canalized Lea Valley to the east of the city; the old metropolitan industries, innumerable light industries, many of them traditional in character; and the new suburban industries, spreading outwards into the country, especially to the north and west.

Since the World War, although industry as a whole has been on the decline in Great Britain, London has experienced a phenomenal growth of manufacturing.

This development has been analyzed by Douglas H. Smith in "The Industries of Greater London" (P. S. King Son, London, 1933). In Middlesex, the center of most rapid industrial development, the population increased 30 per cent between 1921 and 1931. During the same period the population of Great Britain increased 5.5 per cent, and that of the industrial north and of South Wales actually decreased.

Three zones of industrial expansion are described: the Lea Valley, West Middlesex, and the outlying northwest section, including St. Albans, Welwyn, and Uxbridge. The Lea development may be regarded as an extension of prewar conditions; that of the northwest is chiefly postwar. Little specialization occurs, and the expansion is due chiefly to the establishment of new firms rather than to the migration of existing industries from other parts of the country. Cheap land, a large local market, the construction of arterial highways, and the presence of six major railway systems are the chief reasons for the development in the northwest. During the war extensive tracts of land in this area were used for airplane and munition factories, and since 1920 many of these have been opened to private enterprise. Only at Welwyn and Letchworth, however, has there been any attempt at industrial planning.

In the past a laissez-faire attitude has dominated the growth of London. Sir Christopher Wren's plan for rebuilding the city after the fire was never put into execution. During the period of rapid railroad expansion in the second quarter of the nineteenth century, a unified building plan might have given London an adequate railroad network and to a large extent determined the direction of peripheral growth. An analogous situation is now developing as a result of the introduction of motor traffic and the building of arterial highways, and new areas are being opened to settlement. The expense of extending water mains, electricity, and paving is already resulting in ribbon development along the through highways, and lack of zoning may result in the encroachment of industry on residential sections. But an unusual opportunity still exists for local authorities to correlate two phases of urban development—a rapidly increasing population and industrial expansion into previously unoccupied areas.

LOIS OLSON

AFRICA

The Evolution of the Congo Basin. In 1932 P. Fourmarier (Le bassin du Congo *Ann. de Geogr.*, Vol. 41, 1932, pp. 49–69; reference pp. 67–68) restated his opinion that the "big bend" of the Congo River was of Cretaceous origin. His explanation called for a widespread Cretaceous peneplain on the surface of which streams flowing westward to the margin of the Cretaceous sea found themselves in a position to capture northward-flowing drainage. A. C. Veatch (Evolution of the Congo Basin, *Geol. Soc. of America Memoir 3*, 1935) describes a well developed mid-Cretaceous peneplain preserved beneath the coastal-plain sediments of the west coast of Africa, but he finds that during a period of increasingly marked uplift this peneplain was completely eroded to the east. By mid-Tertiary (Miocene) time a new peneplain of great extent had reached its maximum development. The relationship between these two surfaces is somewhat suggestive of the fall zone and Schooley peneplains of the Atlantic seaboard of the United States. But the comparison can be carried no further. The mid-Tertiary peneplain was uplifted on a continental scale to plateau heights. Veatch believes that it was on this uplifted and gently warped surface that the present drainage was begun. In its undissected state it forms the broad (500 miles) divide in Katanga between the Congo and the Zambezi Rivers. In places it has been largely destroyed by the formation of an end-Tertiary erosion surface on the weaker rocks of the continental Karroo deposits. East of the 25th meridian the country has been profoundly altered by late-Tertiary–Pleistocene rift faulting. M. Robert points out (Géographie du Katanga, *Bull. Soc. Belge d'Études Géogr.*, Vol. 5, 1935, pp. 244–268; reference on p. 267) the strong influence of the undissected pene-

plain surface of Katanga—presumably Veatch's mid-Tertiary peneplain—on the vegetation and contrasts it with the more dissected areas. His map showing distribution of little-dissected erosional surface really serves the purpose of a phytogeographic map.

A Description of Ifni. Eduardo Hernández-Pacheco was the leader of an expedition to Ifni, the tiny Spanish enclave in southwestern Morocco. His report on the geography of the region is the first scientific account of Ifni (*Bol. Soc. Geogr. Nacional*, Vol. 75, 1935, pp. 515–541). Ifni has a coast line 70 kilometers long and extends inland about 25 kilometers; it thus has an area of about 1700 square kilometers, which is inhabited by a population estimated at 25,000 people. The country can be divided into four distinct regions: a narrow coastal plain, flanked by a zone of hills 200 to 400 meters high, behind which is a low interior plateau, bounded on the east by a range of low mountains 400 to 600 meters high. The central highlands are mainly of granite, but in the south slates of the lower Paleozoic are found. Volcanic activity was at one time very great in this area. Deposits of phosphate rock and of manganiferous iron ore are of some importance.

Ifni enjoys a maritime climate similar in many respects to that of the eastern islands of the Canaries. The hot season lasts only from the middle of August to October, when it rains. Precipitation is confined to two short periods in the spring and fall, but the downpours are so sudden and violent that, as the local saying goes, "when it rains you can't hear yourself talk." In such a climate xerophilous plants thrive. On the coastal plain the humidity of the atmosphere favors plant life. Euphorbiaceous plants thrive in the entire region, but the characteristic plant of Ifni is the *Argania sideroxylon*, a low tree with wood so hard that it is known as the *palo de hierro* (iron tree). An oil similar to olive oil is extracted from the seeds of the argan tree, which is as important here as the olive tree in Mediterranean economy. Goats and camels feed on its small coriaceous leaves and the pulps of its yellow fruit, the size of a cherry. The most important industry is grazing in these groves of argan trees. Goats, camels, and sheep supply milk, cheese, meat, and wool; the donkey is an important beast of burden.

On the nonirrigable land, *secano*, of the central plateau barley and a very hardy variety of wheat are grown. In the valleys, where there is irrigable land, *campo regadío*, maize is the chief crop. Figs, pomegranates, grapes, tomatoes, peppers, eggplants, beans, and pumpkins are also grown in small quantities. No settlement is without a number of beehives, from which is derived the honey used in the preparation of a dish invariably served at each meal.

Although land, whether in pasture or under cultivation, is generally owned by individuals, some tribes have common pasture lands. The people live in scattered settlements in huge one-story houses, where living rooms, granaries, and stables are under one roof. The house is really a fortress, heavily walled and surmounted by a watchtower. An enclosed corral is usually found near by. There are no urban agglomerations. The expedition reported three favorable sites along the coast at any one of which an adequate port for modern vessels might be established; landing fields could be located without much difficulty almost anywhere on the coastal plain.

A topographic sketch map of Ifni may be found in the account "Datos acerca de la exploración geológica de Ifni" by E. Hernández-Pacheco and F. Hernández-Pacheco in the *Boletín de la Sociedad Española de Historia Natural* (Vol. 36, 1936, pp. 155–176).

RAYMOND E. CRIST

ASIA

Quelpart and Dagelet. Each of the smaller and more isolated inhabited islands of the Japanese Empire has developed cultural characteristics of its own. Some, such

as Sado (R. B. Hall: Sado Island, *Papers Michigan Acad. of Sci., Arts and Letters*, Vol. 16, 1931, Ann Arbor, 1932, pp. 275–297), Oki, Iki, and Tsushima, reflect the centuries of cultural and political associations with old Japan; others, such as Quelpart (Saishu) and Dagelet (Utsuryo), are Korean in their broader relations but have developed many individual culture traits.

In "Quelpart und Dagelet" Hermann Lautensach (*Wiss. Veröffentl. des Museums für Länderkunde zu Leipzig*, No. 3 (N.S.), 1935, pp. 177–206) has given us the first comprehensive geographical description, in a Western language, of the isolated Dagelet Island, 130 kilometers off the east coast of Korea, and has appreciably added to, and brought up to date, our knowledge of Quelpart Island (see R. B. Hall: Quelpart Island and Its People, *Geogr. Rev.*, Vol. 16, 1926, pp. 60–72). If in the introductory philosophical section the parallelism drawn between the Korean and Iberian Peninsulas is a bit farfetched, his accounts of the two islands are excellent. Two aspects of the study are of particular interest. One is the contrasts between the two islands; the other is the differences between the north and the south sides of Quelpart. Quelpart belongs to the "Middle Ages" of Korean culture. Its culture landscape has long been static. On Dagelet, in contrast, there are vigor and expansion along the lines of modern agriculture. This, in part, is expressed in a population density of 512 to a square kilometer, whereas Quelpart boasts but 223. The extensive pastures and accompanying animal industries of Quelpart are lacking on Dagelet, but Dagelet's forests occupy about 70 per cent of the land, as compared with 25 per cent on Quelpart. The white potato is a predominant crop on cooler Dagelet but is lacking on the other island. The white potato and maize are recent introductions, which have been readily adapted on Dagelet but have not penetrated the economy of Quelpart. In contrast, wet-field taro, a relict form, still persists. On Quelpart millet (34 per cent of the arable area) and barley (24 per cent) dominate the agriculture; on Dagelet maize (26 per cent) and white potatoes (25 per cent) predominate.

The north and south coasts of Quelpart reflect the directions of the Tsushima Current and the monsoon winds. On the south coast evergreen broadleaf plants are more numerous and luxuriant, and their zone extends up to 400 meters, as compared with 300 meters on the north slopes. The camellia is found as high as 700 meters in the south but only 300 meters in the north. A few plants are deciduous in the north but evergreen in the south. Temperature and precipitation and a growing season a week longer favor the lower south slopes and lowlands for agricultural use more than those of the north.

ROBERT BURNETT HALL

The Place of Hokkaido in the Japanese Population Problem. Of the problems confronting Japan today none presses more urgently than that of providing for the rapidly increasing population. How far can an internal redistribution of population help? In particular, what relief can be expected from the development of Hokkaido? Alfons Scheinpflug in an extensively documented monograph (Die japanische Kolonisation in Hokkaido, *Mitt. Gesell. für Erdkunde zu Leipzig 1933–1934*, Vol. 53, 1935, pp. 5–132) attempts to answer this question by a review of the history of Hokkaido colonization and a study of present conditions and trends.

Temporary occupation of Hokkaido, by Japanese fishermen and traders, occurred as early as the seventh century, but permanent settlement, mostly by political and other refugees, did not come into existence for nearly five hundred years thereafter. The early population was small and was confined to the southwestern part of the Hakodate peninsula; to the north the Ainus held the land and successfully resisted displacement until the sixteenth century. From 1590 to 1789 the Japanese population of this fishing state of southwestern Hokkaido increased from 12,000 to 30,000, and the Ainu population of Hokkaido decreased from 50,000 to 20,000.

Russian encroachment and actual settlement in northern and northeastern Hok-

kaido caused the Tokugawa government at Tokyo to assume control in 1789. From the fall of the Tokugawa regime to 1882 the *Kaitakushi* (Department of Colonization) controlled efforts to settle the island; since 1882 the Hokkaido government has exercised this control. Early attempts at colonization were handicapped by poor communication, and occupation was confined to the coast; only with the completion of rail lines was the interior opened to settlement (cf. D. H. Davis: Agricultural Occupation of Hokkaido, *Econ. Geogr.*, Vol. 10, 1934, pp. 348–367).

Since 1900 the Japanese population has tripled, but in the past decade net immigration has decreased. The peak of 70,010 net immigrants was reached in 1919; by 1930 the number had dropped to 33,891; since 1930 there has been another decrease. The center of population is also shifting as excess of births over deaths in the more densely populated areas more than offsets movement into the newly opened, less desirable areas of the east and northeast (cf. D. H. Davis: Present Status of Settlement in Hokkaido, *Geogr. Rev.*, Vol. 24, 1934, pp. 386–399). Insufficient and often apparently conflicting statistical data make accurate quantitative statements impossible, but regarding these general trends there is no question.

With increasing age of settlement the former marked preponderance of males in the population is disappearing slowly, and the character of the immigration is changing. In the period from 1890 to 1920 most of the immigrants settled on farms; today they move to the towns. Of the present emigrants, those from the farms ordinarily move to Karafuto; others return to the industrial centers of the southern islands.

The present population of Hokkaido is 2,812,000, about 72 per cent rural. Most of the desirable agricultural land is in use; density of agricultural occupation of the southern islands is precluded by climate and the related farm economy. Further increases of population must be confined largely to the cities and will depend on the expansion of industry. Hokkaido does not offer any permanent solution of Japan's problem of overpopulation. This is the consensus of opinion of all who have studied the question.

DARRELL HAUG DAVIS

Climate and Soil Formation in South India. In 1929 the International Society of Soil Science invited the Geological Survey of India to assist in preparing a soil map of India. The Survey appointed a subcommittee for the purpose, and this bore fruit in an "Introductory Note on the Geological Foundations of the Soils of India" (by D. N. Wadia, M. S. Krishnan, and P. N. Mukerjee, *Records Geol. Survey of India*, Vol. 68, 1934–1935, pp. 363–391). In a foreword the Director of the Survey regrets that in the present state of knowledge it is not possible to publish a soil map of India that would even indicate at all accurately the boundary between the different general types of soils. Two maps, however, are given, a generalized geological map and one showing approximately the distribution of the more important and special types of soils in India. The latter map is based fundamentally on geological considerations but incorporates information from the agricultural departments of India and other sources. The author of "Klima und Bodenbildung in Südindien" (Norbert Krebs, *Zeitschr. Gesell. für Erdkunde zu Berlin*, 1936, pp. 87–101) does not seem to have noticed this paper, appended to which is a very valuable bibliography; but, recognizing the need for more accurate information about the origin, distribution, and boundaries of Indian soils, he has made his own contribution to the subject. After describing his observations in the field he sums up his findings with the aid of a map and a chart. The map is shaded to show the number of rainy days in "South India," i.e. south of the Tropic of Cancer; and the occurrence, rather than the distribution (*Verbreitung*), of soil types according to the author's own observations and reliable literature is indicated by symbols. The black soil, the eastern boundary of the thick laterite crusts found along the west coast, and the iron clay derived from the thick laterite crusts, are distinguished. The chart shows the correlation of soil

types with mean annual rainfall and rainy days. Black soil, the "regur" of Indian terminology, is shown to occur where the annual rainfall is between 500 and 800 millimeters and the rainy days are 30 to 50; it is also found, exceptionally, in the higher Western Deccan in places having 1000 millimeters a year and more rainy days than 50. With 750 millimeters a year and 45 rainy days, iron clay begins on basic rocks but becomes general only where there are 70 to 75 rainy days and 1250 millimeters of rain a year and where there is at least one month with 250 millimeters. Regur and iron clay lie side by side with "recent" laterite crusts, which cap only areas of flat relief. These crusts, Krebs believes, occur at all levels up to 1600–1800 meters. He notes that this is rather higher than the limit given by C. S. Fox (Geological Survey of India). Above this altitude low evaporation in the winter season precludes the formation of the crusts, and humus soils occur as in temperate latitudes. The forest soils of the South Indian plantations form a transition between these and the laterite. The author cannot, from his Indian experience, confirm Lang's view (R. Lang: Die klimatischen Bildungsbedingungen des Laterits, *Chemie der Erde*, Vol. 1, 1915) that laterite is not found in areas having more than 1800 millimeters of rainfall, nor can he draw so definite a border line between "high" and "low" laterite as Indian geologists do. But he discriminates more sharply between "recent" and "fossil" laterite. Only the latter, he emphasizes, is widespread in South India, owing to favorable climatic conditions in, he believes on morphological grounds, the Tertiary period, not the last ice age. Krebs's statement that regur and laterite are essentially mature formations and the expression of relief and climate, not geology, is of course generally accepted. He adds a note that in border regions between zones rich in rain and poor in rain are areas in which the different degree of iron and clay contained in the parent rock determines the soil type.

A. V. WILLIAMSON

Monthly Fluctuations of Sea Level in Ceylon. The basic determination of mean sea level for use in geodetic leveling is most conveniently done through tidal observations. Such determinations bring to light fluctuations in sea level that are seasonal and more or less local. Obviously such fluctuations must arise from seasonal variations in such agents as winds, atmospheric pressure, fresh-water flow, currents, and the like. But the precise evaluation of the effects of each of these agents is generally difficult.

In an article entitled "Tidal Observations in Ceylon" (*Empire Survey Rev.*, Vol. 3, 1935–1936, pp. 325–334) J. E. Jackson investigates the differences in monthly values of sea level between the east and west coasts of Ceylon. In a year these differences may amount to as much as a foot or more. No clear connection between them and local meteorological conditions could be traced. But on computing the differences in monthly sea level that should arise through the action of the deflecting force of the earth's rotation on the currents along the coasts they are found to resemble more or less closely the corresponding differences in sea level actually observed. As the author notes: "Currents should be allowed for, if possible, when a determination of mean sea-level is being made, and especially when levels at places widely separated are being compared."

H. A. MARMER

THE OCEANS

Atmospheric Circulation over the Indian and South Pacific Oceans. The Manila Central Observatory of the Philippine Weather Bureau has recently issued a publication (C. E. Deppermann: The Mean Transport of Air in the Indian and South Pacific Oceans, 1935) that forms a welcome supplement to Werenskiold's analysis of air movement over the North Pacific (W. Werenskiold: Mean Monthly Air Transport over the North Pacific Ocean, *Geofys. Publikationer*, Vol. 2, No. 9, 1922). The basic

data of Father Deppermann's investigation, as of Werenskiold's, are the wind roses on the Pilot Charts issued by the Hydrographic Office of the U. S. Navy. But whereas Werenskiold worked up the data into continuous streamlines, Father Deppermann has contented himself with mapping arrows that show by their length and direction resultant wind movement through each of the five-degree squares of the Pilot Charts. He gives a cogent reason for his preference: "he could not help but feel that many of the lines of convergence and divergence on Werenskiold's maps, for regions where the resultant air flow is very small, have but little significance in fact and might easily lead to wrong impressions, masking the stream lines of stronger weight."

In one respect Father Deppermann has improved on Werenskiold: by computing convergence and divergence, in arbitrary units, and plotting the results in the form of isarithms on maps that as printed face and supplement the maps of resultant wind flow. He did not use the elegant procedure appropriate to analysis by streamlines (cf. V. Bjerknes and collaborators: Dynamic Meteorology and Hydrography, Part 2, Kinematics, *Carnegie Instn. Publ. No. 88*, Part 2, Washington, 1911, p. 151 and Fig. 109, p. 153), but an approximation, carried out as follows: The centers of the five-degree squares on the Pilot Charts were considered corners of interpolated squares of the same extent, and the wind roses centered at these corners. The wind roses were then reduced to four components, southwest, northwest, southeast, and northeast, taken as representative of flow into and out of the interpolated squares, concentrated at their corners. The four components affecting each square were then added algebraically. If the sum showed more air entering than leaving the square, convergence was indicated; if the contrary, divergence. As would be expected, a considerable amount of smoothing was required before these residuals could be used for drawing isarithms.

Father Deppermann presents his maps of convergence and divergence as substitutes for maps of precipitation over the oceans, convergence being indicative of precipitation. If one compares them, so far as the tropical parts of the oceans are concerned, with Gerhard Schott's maps of cloudiness in the extreme seasons (*Annalen der Hydrogr. und Marit. Meteorol.*, Vol. 61, 1933, Pl. 36 and 37; Geographie des Indischen und Stillen Ozeans, Hamburg, 1935, Pl. 17 and 18), one finds good agreement. They cannot be compared with Schott's map of precipitation, since they are drawn, like the Pilot Charts, by months for the Indian Ocean and by quarters of the year for the South Pacific, whereas Schott's map shows annual totals. They may be compared, however, with the annual march of precipitation at island stations; such a comparison with records from islands in the South Pacific shows, with the notable exception of the Galápagos, a good qualitative agreement. Complete agreement, assuming that horizontal convergence is completely known, would require that temperature and specific humidity of the air, vertical component of velocity, and height of ascent in convergence be everywhere accurately balanced. These conditions are certainly not fulfilled; under the circumstances the agreement established may be considered satisfactory, and the attainment of the purposes of the maps, probably as fully as the primary data permit, be granted.

JOHN LEIGHLY

PHYSICAL GEOGRAPHY

A Contribution to the Theory of Climatic Fluctuations. In an article entitled "Teleconnections of Climatic Changes in Present Time" (*Geografiska Annaler*, Vol. 17, 1935, pp. 242–258) Anders Ångström has made a cautious advance into scientific territory that has been the scene of much reckless rushing in of inquirers far less qualified than he. His first step is to classify the factors that may produce widespread simultaneous climatic fluctuations, as follows:

1. Changes in the amount of solar energy reaching the earth, resulting from variations in (*a*) amount of radiation reaching the upper surface of the atmosphere

(i.e. the solar constant), (*b*) transmission of radiation by the clear atmosphere, and (*c*) mean cloudiness.

2. Changes in the atmospheric circulation.

3. Changes dependent on phenomena whose influence on weather is still obscure, such as corpuscular radiation from the sun and number of nuclei of condensation.

The methodological basis of his own investigation may be summarized in two propositions: (1) The interaction of the processes of radiation and circulation is so close, and the results of the interaction are so complex, that discovery of the causes of a given climatic fluctuation by empirical analysis is difficult if not impossible. (2) Therefore empirical investigation must be preceded and accompanied by theoretical clarification of the effects of variations in the factors named. This formulation is a moderately phrased protest against seeking the causes of widespread simultaneous climatic fluctuations exclusively in variations in the solar constant. Changes in this quantity having the amplitude of those observed will produce, Ångström computes, fluctuations in temperature of the order of .4° C. in latitude 60° and of perhaps twice that amount at the equator; but these fluctuations can be recognized only if they are not masked by the effects of other processes.

The other processes discussed are "1*b*" and "2" of the above list. Ångström's exposition of the effects of changes in the transmission of solar radiation by the cloudless atmosphere proceeds from W. J. Humphreys' well known compilation of data correlating weakened reception of solar radiation and consequent lowered temperatures with the spread of volcanic dust through the atmosphere. Any hypothetical effect of change in solar activity is, in the record of temperature, superimposed upon the proved effect of change in the turbidity of the atmosphere. Ångström questions whether, if the effect of variations in atmospheric turbidity were eliminated from the temperature record, there would remain any notable fluctuations to be compared with the sunspot curve. His skepticism makes it worth the while of anyone interested in the problem to reëxamine Humphreys' figure showing the parallel march of temperature, sunspot numbers, and volcanic eruptions (Volcanic Dust and Other Factors in the Production of Climatic Changes, and Their Possible Relation to Ice Ages, *Bull. Mt. Weather Observatory*, Vol. 6, 1913, pp. 1–34, Fig. 5, and *Journ. Franklin Inst.*, Vol. 176, 1913, pp. 131–172, Fig. 5; Physics of the Air, Philadelphia, 1920, Fig. 194, and 2nd edit., New York and London, 1929, Fig. 227).

Ångström's discussion of process "2," variation in intensity of the atmospheric circulation, presents a considerable body of new material. Although based on slightly different theoretical grounds, his argument has much in common with one by Albert Defant, published in 1921 (Die Zirkulation der Atmosphäre in den gemässigten Breiten der Erde: Grundzüge einer Theorie der Klimaschwankungen, *Geografiska Annaler*, Vol. 3, 1921, pp. 209–266). It proceeds, that is to say, from the powerful conception of atmospheric circulation as a process of macroturbulence, the most important climatic effect of which is the transport of heat from low to high latitudes. Increase in intensity of the circulation must on the average raise temperatures in middle and high latitudes and lower them in the tropics; decrease in intensity must have the opposite effect. The node of the fluctuation is in about latitude 33°. Ångström performs an empirical test of the theory by computing coefficients of correlation in winter temperatures between Uppsala and a series of stations ranging in longitude from San Francisco to Irkutsk and in latitude from Alexandria to Ivigtut. He finds the correlations in fair accordance with theory. The computed coefficients have the appropriate algebraic signs, though their numerical values become small far to the east and to the west of Uppsala. This result is not to be wondered at inasmuch as the theoretical formulation takes account only of the meridional component of heat transport, dependent on circulation between high and low latitudes, whereas what may be called its monsoonal component, dependent on circulation between continent and ocean, is left out of consideration. It is to be hoped that the

theory may be modified so as to take account of both components, perhaps by incorporation of the methods developed by Heinz Lettau (Zur Berechnung des meridionalen Austauschkoeffizienten, *Gerlands Beiträge zur Geophysik*, Vol. 39, 1933, pp. 426–430; Gross-Austausch über Europa und dem Nordatlantik im Winter 1931, *ibid.*, Vol. 40, 1933, pp. 390–398; Atmosphärische Zirkulation auf der nördlichen Halbkugel im Lichte der Turbulenzvorstellungen, *Annalen der Hydrogr. und Marit. Meteorol.*, Vol. 62, 1934, pp. 252–256; and—particularly—Luftmassen- und Energieaustausch zwischen niederen und hohen Breiten der Nordhalbkugel während des Polarjahres 1932/33, *Beiträge zur Physik der freien Atmosphäre*, Vol. 23, 1935, pp. 45–84), since it is the most promising approach yet devised toward the solution of a climatological problem of the utmost importance.

JOHN LEIGHLY

HISTORICAL GEOGRAPHY

Was Bering Strait Known in the Sixteenth Century? The Strait of Anian, separating Asia and America, appears first on a map of Bolognino Zaltieri dated 1566. Zaltieri's conception, which is probably traceable to the Venetian cartographer Giacomo Gastaldi, is important in the history of geography for two reasons. In the first place, it marks the definite triumph of the idea that Asia and America are separate continents, an idea that had grown slowly during the sixteenth century as Portuguese discoveries had forced the abandonment of the older Columbian view. In the second place, the actual way in which the separation is indicated corresponds surprisingly to the facts.

The discovery of Bering Strait is credited to the Russian Dezhnev in the year 1648, and its rediscovery to Bering in 1728. How, then, is the remarkable anticipation of Gastaldi to be explained? In "Eine Kenntnis der Bering-Strasse im 16. Jahrhundert?" (*Petermanns Mitt.*, Vol. 81, 1935, pp. 122–125) Richard Hennig attempts to show that it was probably based on Spanish accounts, now lost, of actual voyages in the waters of the northern Pacific Ocean. As he himself admits, there is no positive evidence to support this view. In the main he contributes little to the solution of the problem, which was studied more thoroughly by George E. Nunn in his "Origin of the Strait of Anian Concept" (Philadelphia, 1929). Unfortunately this excellent study was privately printed in an edition of only 200 copies, and it appears possible that Hennig has not made use of it, or of all the numerous works cited in it. According to Nunn, "the study of the Strait of Anian must not be confined to either the Spanish accounts of exploration of the Pacific and Western America, or to Marco Polo's account of his travels. Equal notice must be taken of American and Asiatic exploration because the investigation of the unknown portion of the world proceeded as well from Asia toward the East as from Europe toward the West."

It is interesting to note the newly discovered "Marco Polo map," which Colonel Lawrence Martin of the Library of Congress presented before the 1933 meeting of the Association of American Geographers (see *Geogr. Rev.*, Vol. 24, 1934, p. 314). This map, purporting to have been drawn by Marco Polo's daughter Moreta, shows the east coast of Asia, Bering Strait, and Alaska with astonishing accuracy. It seems quite possible that the map is a forgery. Nevertheless, if it could be shown that this region was known to Chinese cartographers before the coming of the Spanish and Portuguese, there would be some presumption for the authenticity of this document.

DANA B. DURAND

GEOGRAPHICAL REVIEWS

Rebuilding the Public Domain

The Western Range. xvi and 620 pp.; maps, diagrs., ills., bibliogrs., index. *74th Congr., 2nd Sess., Senate Doc. No. 199*, 1936.

The theme of this important document is the rebuilding of the public domain wasted by neglect and misuse and maintained at best in a precarious condition because of the delicate balance between the natural forces of a climate in the main highly variable and of range vegetation which at best covers but 20 to 50 per cent of the ground and suffers even greater volumetric variation than the rainfall. Man cannot on a large scale change rough land to smooth land or a dry region into a wet region, nor can he change some of the underlying conditions of the soil; but he can exercise a certain measure of control over the plant cover. By doing this he can offset, in part, severe climatic effects, reduce the erodibility of the soil, prevent the more rapid spread of noxious or unpalatable plants, and in some places eliminate and in others reduce floods and dust storms or "black blizzards." In addition, if he can increase the length of weather forecasts, he can safeguard against the worst climatic effects by reducing the number of grazing animals upon a stricken range while the stock is in fair condition. It is within these limits and by these and other means that it is sought to improve the Western range and bring about a permanent conservative use, having in mind all the interests at stake. These interests are not alone those of the stockman but also those of the cities and industries that depend on watershed protection. The national forests and other timbered areas as regards lumber crop, recreation, and wild life also come into consideration.

The report first makes clear what has happened to the Western range and then proposes remedies through research, extension work, and legislation. More than 100 million acres of range lands have been so abused by grazing that most or all of the better topsoil is gone, and it is this topsoil that largely conditions both moisture content and nutrition values. On more than a third of this vast acreage destruction has been desertic in effect, and it will be necessary to reseed the range because it has been virtually destroyed either by overgrazing or by plowing and subsequent abandonment. This will take from 25 to 50 years, judging by experiments in Montana, Colorado, and Utah, and it is at best a very expensive process, in general exceeding the value of the land. Nearly half the depletion of the California forage ranges is ascribed to the 85-year progressive decline in rainfall. In New Mexico the peaks in number of livestock on the range correspond with the droughts! In Utah there are not more than a dozen well-cared-for private ranges. To reach safe and permanent grazing capacity there is required a 38 per cent reduction of livestock on the whole Western range area and a 43 per cent reduction on that part of it that is public domain, the latter now being 67 per cent depleted. What reduction and good range practice will do is shown in the Manti Valley, Utah. Flood followed flood after 1888, when ranges had become so depleted that erosion got in its deadly work. It was said that the bands of sheep could be counted by the dust clouds that they raised. Good range management was introduced, and floods have been unknown since 1910.

The tempo of destruction has been progressively swifter as the best land went into private ownership. The homesteader supplemented his private range by pasturing the adjacent unimproved public domain, and he did this without the knowledge or the regulation now known to be indispensable if natural seeding and forage volume are to be maintained. Moreover, there is hardly a year when drought does not imperil some local range. As a result of the 1934 drought there was found to be a 77 per cent decline in grass on experimental protected plots in Arizona. It takes from three to five years of favorable precipitation to restore drought-depleted stands of "sod-forming grasses and good-seeding bunchgrasses" even under conservative grazing.

As three years out of ten have 75 per cent or less of average regional rainfall, this means conservative grazing all of the time. If overgrazed, a stand of grass will not recover immediately with rain but will continue to decline for a year after the drought is broken, and further time is required for the palatable grasses to recover against the encroachments of the unpalatable weeds and shrubs.

The objectives of a sound range policy should be permanently realizable wealth; and to attain them we need both intelligence and desire in stockmen and in legislatures. To meet the situation there is required (*a*) a limited rearrangement of the geographic distribution of range plants, the breeding of new plants, the further importation of drought-resistant and quick-seeding or short-cycle plants from the Old World and elsewhere; (*b*) improved reseeding technique in order to get the cost below the value of the land; (*c*) regionalized and seasonalized grazing practices so that grazing will bear a known relation to plant regions and seasons; (*d*) establishment of an equally rational relation of water storage and water recovery to grass by closer spacing of wells and reservoirs wherever the ground water permits; (*e*) abandonment of uneconomic "mosaics" of small holdings of private and public land; and (*f*) maintenance of a realistic relation of all the foregoing to freight rates, market differentials, production and market distribution, price fluctuations, and the like, by everlasting attention to priorities and science and common sense. The fanatic, the man who "redoubles his effort after he has forgotten his aims," has no place in such a scheme. These last observations may be permitted the reviewer in closing his remarks on a most excellent government document, which, with its new maps, especially of forage depletion and grazing capacity (Figs. 38 and 85), will long be a most useful handbook on the subject and an inspiring source of material for the geographer.

ISAIAH BOWMAN

SOUTHERN REGIONS OF THE UNITED STATES

HOWARD W. ODUM. **Southern Regions of the United States.** xiv and 664 pp.; maps, diagrs., bibliogr., indexes. The University of North Carolina Press, Chapel Hill, 1936. $4.00. 10 x 7½ inches.

"As to resources—superabundance; as to science, skills, technology, organization—deficiency; as to general economy—waste; as to culture—richness, with immaturity and multiple handicaps; as to trends—hesitancy and relative retrogression in many aspects of culture." Professor Odum thus sums up the situation in the South today.

Since the World War students of Southern affairs have become increasingly aware of the gravity of the social and economic problems facing the South. This awareness has borne fruit in a comprehensive regional study carried out under Professor Odum's direction for the Southern Regional Committee of the Social Science Research Council. In the volume under review the main conclusions are set forth, together with many of the detailed findings regarding the Southeast. A special study of the Southwest (Oklahoma, Texas, New Mexico, and Arizona) was undertaken by Professor R. D. Thomas of Oklahoma Agricultural and Mechanical College and Professor J. J. Rhyne and C. R. Rhyne of the University of Oklahoma.

"Southern Regions of the United States" is, first and foremost, a description and appraisal of the contemporary South, a "picturization" that includes within its framework natural resources, agriculture, industries, transportation, population, education, politics, religion, and general culture. Into the composition of this picture has gone an enormous body of statistical data.

These data are presented not only in the text but in several hundred diagrammatic maps, charts, and tables. The point is emphasized that no adequate concept of the South—or of any other region, for that matter—can be gained without the aid of comparisons with other regions. Hence many of the maps show the whole United

States, and many of the tables give figures for every state as well as totals for six main regions of the country. Thus the volume forms a veritable atlas and compendium of social and economic information regarding the country as a whole. Basic to the regional study is the regional division. The United States is divided into six main regions: Northeast, Southeast, Middle States, Northwest, Southwest, and Far West (maps on p. 6). The claim is made that "no other classification has been presented which will approximate so many of the desired points or conform so well to the largest number of those now in use for specific purposes." Each region "is an empire of territory and wealth in itself. Each is greater and more self-sufficing than many nations of the world. Each is incurably sentimental and patriotic about its own virtues and assets."

Only through the regional approach will it be possible "to build permanent foundations for national unity, to attain social and mental freedom, to develop creative research and discovery, or to achieve economic rehabilitation, sound legislation aptly adapted, and strong autonomous movements well integrated with the new public administration." A distinction is made between regionalism and sectionalism. Regionalism is good, sectionalism bad. "Regionalism envisages the nation first, making the national culture and welfare the final arbiter. On the other hand, sectionalism sees the region first and the nation afterwards." Regionalism implies in the beginning research in terms of regions, subregions, and their interrelationships; next, on a firm factual basis provided by such research, it implies regional planning, experimentation, and coöperation in putting tested plans into effect. "Sectionalism emphasizes political boundaries and state sovereignties, technical legislation, local loyalties, and confederation of states 'with common interests, menaced by federal action.'" Increasing sectional feeling and cleavage, of which there have been manifestations of late, can lead only toward disaster. The South must seek its salvation in regional reconstruction, and regional reconstruction will be successful only on the basis of "national integration and interregional adjustments." A crisis is "now in prospect in the Southeast due to the diminishing ratio of cotton in the total regional economy of the future." Perhaps the most pressing need of today is for measures to meet and avert this crisis. The development of dairying is suggested as a partial solution of the problem.

Enough has been said to suggest the richness of "Southern Regions" in subject matter and practical idealism. The volume combines the advantages of coöperative and individual research. Definiteness of focus is achieved through authorship by a single writer; but one man working alone could never in two or three years' time have gathered the wealth of detail that lends authenticity to the study. Unfortunately, the literary style, although colorful, is not everywhere so lucid as it might be. Simple ideas seem often to be expressed in an unduly complicated and wordy manner, as in the following example: "An examination of the facts indicates further that much of the culture of the Southeast is more regional in the sense of a time lag than it is conditioned primarily by physiography or regional culture as a separate entity. In this sense it is more regional than southern in the sense that 'southern' has changed and is changing to the extent that 'the South' has changed and is changing."

The Great Soil Groups of the United States

Charles E. Kellogg. **Development and Significance of the Great Soil Groups of the United States.** 40 pp.; maps, diagrs., ills., bibliogr. *U. S. Dept. of Agric. Misc. Publ. No. 229*, 1936. 25 cents. 9 x 6 inches.

"The zonal groups of soils can be conveniently considered as great 'natural land types,' each with its own soil, climate, and vegetation, and each having its own biological dynamic. Man is a part of these great landscapes and he is strongly influenced by them in many ways." This is the principal significance of the great

soil groups for human beings according to Charles E. Kellogg's "Development and Significance of the Great Soil Groups of the United States." To illustrate, a comparison is drawn between the Gray-Brown Podzolic soils of the eastern and east-central parts of the country and the Chestnut soils of the High Plains and the Rocky Mountain region. As the former soils are adaptable to a diversified type of farming, they are less favorable to "fundamental cooperation" among farmers for the protection of economic interests than are the Chestnut soils, which are adaptable primarily to cereal production. The great zonal groups of soil are here said to extend their influence not only to the economic, but also to the esthetic, activities of man. To be sure, wide differences in farming are found within one great soil group, owing to the variations among the smaller soil units of the group. In general, these differences are quantitative rather than qualitative. One soil group produces good, bad, and indifferent farms of one type; another soil group produces good, bad, and indifferent farms of another type.

If the discussion of the "significance of the zonal groups of soils" seems a trifle "deterministic" in tone, this may be ascribed to the author's eagerness to point out the importance of soil study for the "general reader." With unusual breadth of view, however, Kellogg has succeeded in presenting the basis of soil classification in the United States in a simple and thoroughly scientific manner and by so doing has made a valuable contribution to soil science in general.

The several chemical and physical processes of soil development are discussed. Differences in climate and native vegetation are pointed to as the primary factors causing eight distinct soil groups to develop in the United States. Variations within each group are shown to be due to differences in parent rock material, relief, and relative soil age. Summarizing the entire pamphlet are two tables giving, for each zonal and intrazonal soil group, the profile characteristics, native vegetation, climate, soil-developing processes and factors causing the development, natural fertility for crops, and agricultural uses.

ARTHUR R. HALL

THE CONSERVATION QUANDARY

THOMAS BARBOUR AND MARGARET DEWAR PORTER. **Notes on South African Wild Life Conservation Parks and Reserves: A Report Prepared for the American Committee for International Wild Life Protection.** 34 pp.; map, diagr., ills. *Special Publ. Amer. Committee for Internatl. Wild Life Protection No. 7*, 1935. 9¼ x 6 inches.

Agriculture and industry seldom require more than a part of any country. Is there a way in which a self-sustaining use of this occupied part can be dovetailed with a deliberate retention of the natural fauna and flora of the unoccupied remainder? Can the engines wherewith we subjugate land be used with discrimination? Or is their momentum so great that we must sacrifice, willy-nilly, the natural beauty of the whole in order to gain the occupancy of the parts we need? This question is answered, in words, at every conservation meeting, but we conservationists are not the ones who go forth to settle new and naked lands. We make, but do not use, the engines for land subjugation. We turn them over ad libitum to the pioneer. How does he answer our question, in action, on the actual frontier?

The colonizations of the nineteenth century were perhaps not a fair test of this question, because they were nearly completed before we discovered that the things being destroyed were comparable in value with the things replacing them. The new extensions of settlement in south and south-central Africa, however, were seemingly "staged" as a test of the conservation idea. Here the earth's most advanced human societies are extending themselves into the habitat of the earth's richest remaining fauna. With what result?

The document here under review is one of a series describing the successes and

failures of the conservation idea in various continents. (The musk ox of the Arctic, the wood buffalo of Canada, and the waterfowl flights of North America are examples of the problems discussed in previous bulletins.) My outstanding impression of the present paper is that a whole century of history—in particular the history of the American West—is repeating itself in a day. We have in Africa, simultaneously enacted, the whole sequence of events from the exploration of the hinterlands by Jim Bridger to the discovery of "recreation" by the motor tourist. The contradiction most clearly common to both countries is the assumption that conservation must be justified in terms of tourist traffic. To get this traffic we riddle even our roughest and most inaccessible wild-life ranges with roads and thus destroy the esthetic, if not the physical, substance of the thing to be conserved. Result: "empty tins, banana skins, orange peels, paper bags, candy boxes—these betoken the fact that lions may be seen . . . regularly" in the Kruger National Park.

That a genuine conservation movement exists in the African provinces is not open to doubt. A well developed national park system, such as the one described by Barbour and Porter, could hardly spring into existence from tourist-baiting motives alone. As in America, however, the growth of that movement is beset by curious contradictions, reversals, and inconsistencies, marking the clash of opposing ideas. Thus our authors report a border patrol of dried-meat (biltong) hunters operating openly, and presumably legally, on the very boundaries of the African parks. One is reminded of the cordon of elk-tusk poachers that once patrolled the boundaries of the Yellowstone.

Governmental policy toward the large mammals seems to have swung like a pendulum from official killing to clear land for settlement to official sanctuaries for saving the unshot remnants on the same areas. This is at least faintly reminiscent of American bear policy and may, I fear, end with the same result.

In Africa, as in our West, the stockman plays a dual role. Politically he seems to be the chief opponent of conservation policy, but individually he often gets things done while government is only talking about them. Thus the bontebok, we are told, was saved from extermination by the initiative of private stockmen. So also was the pronghorn antelope in some of our Western states. The beautiful springbok, our authors fear, may be damaged by a new conservation law prohibiting market hunting. Certain stockmen, it seems, have built up a profitable business in managing wild springbok herds on their ranches for annual harvesting as meat. The new law would dampen this commercial but effective conservation enterprise.

It was only a few years ago that our national parks abandoned the systematic control of predatory animals. It is hardly surprising, then, to find the African parks controlling predators, both to protect game and to protect tourists. It is easy to imagine that the question of the African-park predator presents a real puzzle, especially in view of the many rare herbivores and the wholesale upset of natural balances outside. Furthermore, Africa presents certain biological puzzles entirely indigenous to her own soil. The most serious of these is the role of game mammals as reservoirs of disease.

ALDO LEOPOLD

THE PASTORAL INDUSTRY IN GREAT BRITAIN

E. H. CARRIER. **The Pastoral Heritage of Britain: A Geographical Study.** xi and 293 pp.; maps, diagr., ills., bibliogr., indexes. Christophers, London, 1936. 10s. 6d. 8½ x 5½ inches.

In "Sheep Farming: A Distinctive Feature of British Agriculture," an address before the 1932 meeting of the British Association, Professor R. G. White pointed out that in proportion to area Great Britain had more sheep than any other country except New Zealand (in 1930 the respective figures were 105.4 and 115.1 sheep to 100 hectares; the United States had 6.6). Even in actual numbers Britain stands

eighth on the world's list of sheep-raising countries. The pastoral preëminence of Britain is of ancient standing, deeply rooted in the natural endowment of the land. This is the theme of "The Pastoral Heritage of Britain," by the author of "Water and Grass," a work that dealt with the pastoral life in southern Europe (see *Geogr. Rev.*, Vol. 23, 1933, pp. 155–156).

"The Pastoral Heritage of Britain" opens with a short discussion of the sheep and cattle pastures and pastoral regime in Britain today. The second part traces the industry from its beginnings (distinction is made between "upper" and "lower" Britain, roughly defined by the 500-foot contour), through the medieval expansion in response to the growing demand for wool both for export and for domestic use, to the "pastoral revolution" of the eighteenth century with improvements in food and forage, breeding and the development of crossbreeds, and the "aid of applied science" (reclamation, irrigation, agricultural chemistry). The third part is concerned more particularly with the human element. It includes observations on such matters as the introduction of large-scale sheep farming by the medieval monks, sheep and cattle raids of the Welsh and Scottish borders, the evictions in the Highlands, famous live-stock drives and fairs, old customs and superstitions connected with pastoral husbandry . . . down to the organization of London's milk supply and other modern developments.

As in "Water and Grass" Miss Carrier's researches have led to the assemblage of a wealth of details, interesting and suggestive. A noteworthy feature of her book is the emphasis laid on the diversity of pastoral Britain—in the character of the pastures according to climate and the mineral constitution of the soils and the corresponding diversity in the stock and their products. The wools, for instance, show remarkable variety in staple, texture, luster, felting properties, such as fit them to the manufacture of a wide variety of fabrics and lead to a world-wide demand—about 60 per cent of Britain's annual wool clip is exported. Similarly Nature can claim a large share in making Britain "the world's stud farm."

"Past Geographies" of England

H. C. Darby, edit. **An Historical Geography of England before** A.D. **1800: Fourteen Studies.** xii and 566 pp.; maps, diagrs., bibliogrs., index. The University Press, Cambridge; The Macmillan Company, New York, 1936. $7.00. 9½ x 6½ inches.

"The Face of Things so often alters, and the Situation of Affairs in this Great British Empire gives such new Turns, even to Nature itself, that there is Matter of new Observation every Day presented to the Traveller's Eye." So wrote Defoe in 1724 at a time when the tempo of change in the cultural landscape of England was beginning to quicken. The course of the change from prehistoric times to Defoe's century is the subject of this series of studies, "past geographies" of England. Apart from the intrinsic interest of their subject matter, the fourteen studies by the editor and his ten collaborators afford a lively demonstration of the varied resources and modes by which past geographies can be reconstructed.

The several chapters are independent essays, but through them runs the thread of persistent difference and variety in the English scene, especially that fundamental difference between northwest and southeast, between mountain and plain. In regard to the cultural provinces of prehistoric days, E. G. Bowen, who writes on this subject, generalizes the west as receiving its culture contacts "in smaller doses—perhaps more by trading and occasional raiding than by massed invasion"; whereas in the southeast "invasion was frequent, and large groups of men and materials could be ferried over the narrow seas." In fact, southeastern England, as E. W. Gilbert points out in his chapter on Roman Britain, was definitely a part of Europe and has never been entirely isolated from the main currents of European affairs. In Roman Britain there was

also this dualism—the civil zone of the southeast and the military zone of the north, Wales, and the southwestern peninsula, which protected the lowlands of the southeast from the incursion of hill tribes, much as the North-West Frontier protects the plains of Hindustan.

If its "legacy of town life" is one of Britain's chief debts to Rome, it was quite otherwise with the Anglo-Saxon settlement, which S. W. Wooldridge characterizes as "a pioneering venture by an agricultural people." Here the nature of the soils is seen as a factor of particular importance, providing "an essential clue in interpreting much of the primary Saxon settlement." Dr. Wooldridge's map of the physical regions of England on a soil basis is noteworthy. He also makes use of the distribution of burial grounds and place names in studying the early Saxon occupation. The work of the English Place-Name Society, he remarks, will put a valuable tool in the hands of the investigator when it is completed; pending this he resorts to Ekwall's study of names in -ing and -ingham. Professor Eilert Ekwall of the University of Lund himself contributes the chapter on Scandinavian settlement—Norse in the northwest, Danish in the east. He makes the point that this settlement was more than a passing episode and the Danelaw far from being merely a "geographical expression."

In considering the economic geography of England between A.D. 1000 and 1250, H. C. Darby has at his disposal evidence provided by a "variety of agricultural documents, by charters of various kinds, by the earlier Pipe Rolls, by the Anglo-Saxon Chronicle, and by other chronicles," and, first and foremost, by the Domesday Book, that exhaustive survey: "'So very narrowly did he cause the survey to be made,' moans the Saxon Chronicler, 'that there was not a single hide nor a rood of land, nor—it is shameful to relate that which he thought no shame to do—was there an ox, or a cow, or a pig passed by, that was not set down in the accounts." Notwithstanding the shock of the Norman Conquest, English life maintained its essential continuity. The village community was the all-important unit of population, the "systematic expression of a mode of life." The "general antiquity and stability of English village geography is one of its most striking features." Herein slowly took shape those "provincialisms which survived so tenaciously, . . . deep-rooted localism that gives to English life its variety and its sense of age-long contact with the soil."

Toward the end of the period the rise of the mercantile towns marked the beginning of changes that came to fruition in the "medieval renascence" of the thirteenth and fourteenth centuries. Rural England was passing out of the subsistence stage, producing corn for export and wool for export and the home cloth industry. R. A. Pelham traces this development in a chapter "Fourteenth-Century England," especially noteworthy for its ingenious maps. The growth of the complex systems of international trade is dealt with through the medieval foreign trade of the ports, the west-coast ports being described by D. T. Williams, the east-coast ports by Dr. Pelham. The east-coast ports, enjoying transport facilities that have been generally underestimated, extended their spheres over a wide hinterland. The Channel ports are discussed with those of the west coast, and Southampton is of course of prime interest.

In "Leland's England" E. G. R. Taylor portrays the scene through writings of John Leland, "a pioneer of the method of direct inquiry and observation." During his survey of the libraries of the monasteries doomed by the dissolution Leland became "totally enflamed with a love to see thoroughly al those Partes of this your opulente and ample Realme . . . and noted yn so doing a hole Worlde of Thinges very memorable." In his day England still faced southeast. Professor Taylor emphasizes the fact that the first discoveries in the New World appear momentous only in the light of subsequent events. By the end of the Tudor period, however, things had changed. "Camden's England" is based on the comprehensive tour in the last 30 years of Elizabeth's reign of another keen observer of landscape. If there was much of permanency in the rural scene, there were beginnings of new developments in

economics and industry, and the outlook had definitely changed. The people were, "in more senses than one, looking out upon a new world." Between J. N. L. Baker's chapter on seventeenth-century and W. G. East's on eighteenth-century England, which trace the general course of progress, the editor has a chapter on the draining of the Fens. Dr. Darby has dealt with the earlier history of the Fens in articles in the *Geographical Journal*. Here he is concerned with a matter that though local was dependent on outside aid. Truly successful reclamation was achieved only when "power could be commanded at will," and thus it is illustrative of happenings significant for the whole country, a forecast of the nineteenth century, when Britain was to become "the workshop of the world."

A final chapter, by O. H. K. Spate, is devoted to the growth of London between 1660 and 1800, the latter date marking the year in which the first stone of the West India Dock was laid and the foundation of the modern port may be said to have had its beginning. References to London in preceding chapters make clear the city's supremacy from its early days. London, says Gilbert, "is definitely a Roman foundation" and "one of the greatest achievements of a race of practical geographers." He quotes the eminent authority Dr. R. E. M. Wheeler: "It was a civilised city, a comfortable one, with an efficient drainage system and an adequate water-supply. There were probably more buildings of stone and brick than at any subsequent period until after the Great Fire of 1666. There were more adequate and attractive facilities for bathing than ever until the latter part of Queen Victoria's reign." London's primary function was that of a trading port and distributing center for the Roman Empire; it was an international, rather than a national, city. And this character it maintained. Whereas the business of most medieval ports was specialized, London was concerned with "every branch of trade." Camden rejoiced in its growth as "the epitome of all Britain, the seat of the British Empire," using the phrase coined by John Dee a quarter of a century earlier.

Whether he is specially interested in England or not, the student of historical geography will, as has been said, find much that is stimulating in this book in the treatment of both textual and map material. He will also find in it no little entertainment; for example, in the way in which present problems are reflected in the past. Tacitus described the minerals of Britain as "the reward of victory"; Pliny refers to the quota law on the export of lead, which "may have been imposed at the request of the proprietors of the lead mines in Spain, after they had begun to feel the effects of British competition." The past is not so remote after all!

Human Geography of Estonia

Edg. Kant. **Bevölkerung und Lebensraum Estlands: Ein anthropoökologischer Beitrag zur Kunde Baltoskandias.** vii and 280 pp.; maps, diagrs., ills., bibliogr. Akadeemiline Kooperatiiv, Tartu, 1935. 9¼ x 6⅓ inches.

Dr. Kant brings down to date an older work, written by his predecessor (Professor M. Haltenberger) some ten years ago, and makes new contributions to the subject under discussion. The presentation is also flavored by the philosophy of Granö, whose "Reine Geographie" has left its mark on Dr. Kant. As the book is an anthropo-ecological consideration of the culture of Estonia, the author has been free to introduce several nongeographical elements to give a balanced interpretation of the life of the people.

There are so many items of interest in this volume that only a highly detailed discussion would do it justice. The census of the principal cities and resort centers expressed on a monthly basis, the historical development of the country expressed in quantitative terms, and the rhythmical fluctuations in the economic life of the country based on latitude and climatic relationships expressed graphically are examples of the suggestive ideas presented by the author. Estonia is looked on as a typical

national state because 88.2 per cent of its population are Esths and "the state plus its habitable area constitutes a sociographical unit."

After a general treatment of the country as a whole, a considerable portion of the book is devoted to Estonia's urban life, focused on the "Tallinn system" and the "Tartu system." These "systems" refer to the chief cities and their satellites.

Throughout the volume are numerous tables, graphs, and maps, many of the maps of the isopleth type. Supplementing the text are half-tone illustrations and a series of maps covering economic subjects primarily apropos of the content. In addition there is an excellent classified and selected bibliography of works in various languages.

EUGENE VAN CLEEF

IN CENTRAL ASIA

GEORGES LE FÈVRE. **An Eastern Odyssey: The Third Expedition of Haardt and Audouin-Dubreuil.** Translated and adapted by Sir E. D. Swinton. 368 pp.; maps, ills. Little, Brown & Co., Boston, 1935. $3.50. 9½ x 6½ inches.

R. C. F. SCHOMBERG. **Between the Oxus and the Indus.** 275 pp.; map, ills., index. Martin Hopkinson Ltd., London, 1935. 15s. 9 x 6 inches.

ELLA K. MAILLART. **Turkestan Solo: One Woman's Expedition from the Tien Shan to the Kizil Kum.** Translated by John Rodker. 307 pp.; maps, ills., bibliogr., index. G. P. Putnam's Sons, New York, 1935. $3.50. 8½ x 6 inches.

EVANGELINE FRENCH, MILDRED CABLE, AND FRANCESCA FRENCH. **A Desert Journal: Letters from Central Asia.** ix and 261 pp.; map, ills. Constable & Co. Ltd., London, 1934. 7s. 6d. 7½ x 5 inches.

"An Eastern Odyssey" is the account of the Citroën Trans-Asiatic Expedition, which set out in April, 1931. There were 40 men in all, divided into two groups, both en route for Central Asia: the Western or Pamir Group, starting from Beirut, under Georges-Marie Haardt, the leader of the expedition; and the Eastern or China Group, starting from Peiping, under Lieutenant Victor Point. Each group was equipped with seven specially constructed motorcars. The two groups met at Aqsu, south of the Tien Shan, in the Tarim Basin. From this point the entire expedition continued eastward to Peiping, which was reached on February 12, 1932. The greatest interest in the expedition lies, of course, in the mode of transport, the difficulties encountered, and the way they were met.

The Western Group followed the royal road of Darius, the "Great Silk Road," which still remains the principal highway across Central Asia. The narrative gives interesting descriptions of the ancient cities visited: picturesquely situated Kermanshah, a crumbling old city of 50,000 people, its caravansaries abandoned since the advent of the motor; Tehran greatly westernized, with half a million inhabitants; Meshed, where old Persia seems to be making its last stand against the advance of modernism.

The great Pamir massif was crossed by the route via Gilgit, which starts near Srinagar. It is only a pack trail, barely a foot wide in places. It descends deep down into the valleys before climbing up to the passes, 16,000 feet high, which connect the Indus and Tarim Basins. It was here that the greatest transportation difficulties were experienced. There are many small wooden bridges far too light to carry a two-ton car. The problem was solved by hauling the unloaded cars across the bridges by cable, the steering being done from behind by a long pair of reins.

Worst of all was the crossing of the Burzil Pass, at an altitude of 13,775 feet, where the ponies hauling the cars sank to their girths in the July snow. Pick and shovel had to be used to make a way, and the rate of travel was reduced to less than a mile an hour, since it was necessary to sound the snow at almost every foot in order to detect possible ice caverns below the surface.

The Eastern Group started for the interior of the continent from Tientsin and continued by way of Peiping to Kalgan and over the Nankow and Kalgan Passes to the Mongolian plateau. If the Western Group experienced the worst transportation difficulties, the Eastern Group met the greatest political obstacles in official delays and banditry.

The journey westward was made from Kalgan, north of the great bend of the Hwang Ho (Yellow River), across the province of Ningsia and skirting the south edge of the Gobi to Suchow, in Kansu, then northwest to Hami, at the entrance of the much-traveled broad gateway of Dzungaria, and on to Urumchi. At Urumchi the group turned south and entered the Tarim Basin by way of the Toksun Pass, keeping to the north rim of the basin until Aqsu was reached, where the two groups were united.

The combined expedition now proceeded eastward from Aqsu, making stops at the dead cities of the Tarim Basin, including the ruins at Kizil Kucha and the famous ruined cities east of Turfan, reminders of the seventh-century glories of the Kingdom of Turfan. At Kara Khoja, 600 feet below sea level, the weather on December 2 was warm, almost balmy, very different from the bitter cold experienced at Urumchi, just over the north rim of the Tarim Basin. The low temperatures of that "frozen heart" of the continent (35°C. below zero) and the lack of water and fuel were serious obstacles. Fires to keep the engines and oil ducts from freezing took so much fuel that the engines had to be kept running, and extra gasoline was thus consumed.

At Suchow the expedition took the more southern caravan road through Kansu to Liangchow. Where this ancient way across the loess country, with its vertical walls 200 feet deep, was too narrow to take the cars, the "national highway," five years old, could be used, and, though poor, it could be followed without the aid of pick and shovel. In the loess it was necessary to travel at "dust intervals," that is about 100 yards apart.

The plans were to go south from Peiping by boat to Haiphong and into French Indochina. Over these plans, however, a shadow was cast by the death of Haardt at Hong Kong on March 16. Tribute to him as organizer and leader is paid by Le Fèvre over and over in his narrative.

The expedition brought back 5000 photographs, 200,000 feet of film, drawings, ethnographical documents, mineralogical specimens, objects of art, and collections of flora and fauna.

The narrative affords much of interest; its style is delightful, and its descriptions are vivid. The two appendixes—the first dealing with the changes of the location of Lop Nor in the Tarim Basin; the second containing some "Geological Observations in China" by Father Teilhard de Chardin, geologist of the expedition—are valuable documents.

Colonel Schomberg's book gives a detailed account of a rugged mountain region in northwestern Kashmir, the Gilgit Agency. It is situated, as the title implies, between the valleys of the upper Oxus (Amu Darya) and the Indus, where the Karakoram, Hindu Kush, and Pamir Mountains unite.

The Pamir Group of the Citroën Trans-Asiatic Expedition crossed this region from south to north, but their accounts are limited to the narrow route followed from Dolan, on the Indus, to the Kilik Pass, on the north border. Colonel Schomberg describes the social and political aspects of the country in their physical setting and gives a concise account of the history of the most important tribes and the influence of the British in these isolated mountain strongholds. There are particularly interesting references to the agriculture of the region: Gilgit is one of the highest places in the world where rice is grown. It pays to raise rice there only because the cost of transportation from Kashmir is so high. It is astonishing that two and sometimes three crops can be raised in the short growing seasons of some of

these high valleys. The descriptions of the glacial scenery in Ishkoman and upper Yasin are excellent.

"Turkestan Solo" is an interesting account of a journey from Moscow across Turkestan to the Tien Shan as far as the border of Sinkiang. The author made the journey to the Tien Shan with a small party of travelers but returned alone. A variety of means of transport was used—horse, camel, bullock, train, cart, and airplane.

In the second part the return around the east rim of Turkestan is described. Stops were made at Tashkent, Samarkand, and Bukhara. Bukhara has the air of being "a city of the past"; its decline is attributed mainly to political causes, including heavy taxation. Samarkand, on the other hand, is a flourishing city. Tashkent, with its 500,000 inhabitants, owes its prosperity to the Syr Darya, which waters the cotton fields of the Ferghana. A trip was made down the valley of the Amu Darya to Khiva and Chimbai, in the country of Kizil Kum, which approaches the east side of the Aral Sea.

East of Charjui, on the Amu Darya, the desert is encroaching on the land at the foot of the mountains at the rate of 40 to 50 yards a year. Special forms of vegetation have been introduced to check the migration of the sand dunes.

The author's descriptions, whether of the magnificent scenery of the high Tien Shan or of the details of household economy in the primitive dwellings or of the ancient cities, alike are interesting.

"A Desert Journal" is a collection of letters written from 1928 through 1932 by three Englishwomen while on a missionary journey into the heart of Chinese Turkestan, via India and China. After many vicissitudes these three plucky people reached the Chinese caravan center of Liangchow, on the Hwang Ho. From there they made their way northwest through Yümen, or the Jade Gate, across Kansu to Suchow, traveling by cart and team along the rough road to Hami, and thence to Urumchi, finally reaching the Turkestan-Siberian railway at Sergiopol.

The descriptions of everyday events, the types of dwellings, the food and clothing of the various peoples they met, the climatic changes, the dust and sandstorms all carry geographical significance. The three women traveled chiefly by cart, varied by riding donkey, horse, or camel, according to the nature of the country they were crossing, and ending with transport by *brichka*, tarantass, and motor truck.

E. Muriel Poggi

Exploration in the Karakoram

P. C. Visser and Jenny Visser-Hooft, edits. **Wissenschaftliche Ergebnisse der niederländischen Expeditionen in den Karakorum und die angrenzenden Gebiete in den Jahren 1922, 1925 und 1929/30,** Vol. 1. xviii and 499 pp.; maps, diagrs., ills., bibliogrs. F. A. Brockhaus, Leipzig, 1935. 11 x 7 inches.

The scientific conquest of the world's highest mountains is progressing rapidly. Since 1922 one or two scientific expeditions have worked in them every year, and four of these expeditions have been conducted by the authors of this volume. Very aptly, the volume opens with a brief history of travel and exploration in the region of the Karakoram to the Kunlun. A review of the three Visser expeditions of 1922, 1925, and 1929–1930 follows. The first account takes the reader to Hunza and opens with a short discussion of physiographic problems a little out of place in this narrative setting. The short journey to the glacier world of Nubra was followed by a longer undertaking, which led the authors over perilous ground from the Siachen Glacier across the Depsang Plateau and through the Kunlun Mountains into Sinkiang. No wonder that Dr. Visser speaks with the authority of an experienced explorer on the treacherous problems of orographic trends and geographic classifications. From north to south four main mountains are recognized: the Kunlun, the Aghil, Kara-

koram, and Himalayan Ranges. The Aghil Range is pictured as a continuation of the Hindu Kush and the Pamirs. The more detailed subclassification into groups follows the geographic scheme as employed in the Alps. This arrangement has the advantage of being free from geological theory, but, on the other hand, it does not give adequate expression of the relationships between geological structure trends and morphology. Its disadvantage is especially apparent in the case of the Karakoram, where northern and southern granite axes reflect the main structure trends.

The ethnographic chapters by Madame Visser-Hooft leave the reader with the desire to know more about the fascinating combination of racial, geographical, and historical factors that determine the anthropological setting of this remote region. The attractive description of religious and social customs gives one the impression that this area is a veritable storehouse for anthropological studies.

The larger part of the book is devoted to zoölogy. Under the direction of J. B., Corporaal, custodian at the Zoölogical Museum of Amsterdam, no fewer than 87 specialists have been enlisted in describing the great number of zoölogical specimens. The thorough study of the insect world makes a welcome supplement to the biological studies under way by Professor G. E. Hutchinson of Yale University.

HELLMUT DE TERRA

REPORTS OF THE SNELLIUS EXPEDITION

P. M. VAN RIEL. **The Bottom Configuration in Relation to the Flow of the Bottom Water.** 62 pp.; maps, diagrs., bibliogr. (The Snellius-Expedition in the Eastern Part of the Netherlands East-Indies 1929–1930, Vol. 2, Part 2, Chapter 2.) Kemink en Zoon N. V., Utrecht, 1934. 12¼ x 9 inches.

F. PINKE. **Depth Determinations.** 67 pp.; diagrs. (*Ibid.*, Chapter 1.) 1935.

P. H. KUENEN. **Geological Interpretation of the Bathymetrical Results.** 123 pp.; maps, diagrs., bibliogr. (*Ibid.*, Vol. 5, Part 1.) 1935.

Before 1929 the number of soundings in the eastern part of the Dutch East Indies from all sources was not far from 3500. As a result of the Snellius Expedition about 35,000 soundings in the same area are now available. Nevertheless, the bottom is so uneven that the true relation between the 27 troughs and basins could not be learned from the soundings alone. In particular, the soundings are still inadequate to determine the exact sill depths of the depressions without resorting to a study of the temperature and salinity observations on the deeper layers. Through an examination of the potential temperature in each basin it is possible to gain exact knowledge of the direction of flow of the bottom waters as well as of the sill depth of the numerous connecting channels. In general, the deeper waters are found to penetrate southwestward from the Pacific into the Celebes and Northern Banda Basins. From the Celebes Basin the movement continues in the same direction through the Strait of Macassar; from the Northern Banda Basin the deep flow is southward into the Southern Banda Basin, from which it spreads westward as far as the Bali Basin and eastward into the Weber Deep. The very complete hydrographic data permit the interpretation of the slow, deep movements of the water in great detail. In addition the report includes a series of 16 detailed charts and two large charts showing the soundings and bottom configuration. These charts are in color, and are most admirably rendered.

C. ISELIN

Pinke's report on depth determinations is wholly concerned with the technical problems connected with the construction of the bathymetric chart. Both wire and echo soundings were used, and every precaution was taken to eliminate all possible sources of error. For the soundings with wire, corrections were made for

wear on the measuring wheel and wire thickness, for the stretch of the wire, for the angle of deviation from the vertical, and for slip on the measuring wheel while the wire was being payed out or reeled in. For the echo soundings, in addition to the usual corrections for temperature and salinity, an attempt was made to evaluate the error introduced by the personal equation. Allowance was also made for the effect of varying water pressure on the ship's hull in a rough sea and its influence on the transmitters and receivers. It was not considered necessary to apply a correction for the effect of bottom slope. Simultaneous soundings were taken with wire, protected and unprotected thermometers, and echo for a comparison of results.

The painstaking and thorough way in which this work has been carried out has resulted in a bathymetric chart as free from error as our present means will allow. It may be regarded as a notable achievement.

Kuenen's report may be divided into descriptive and theoretical parts. The sea basins of the area are separated into more or less distinct morphological units, and a detailed description of each is furnished. The bottom topography, as stated above, is extremely irregular. One of the most surprising results of the survey was the discovery of numerous fault scarps, some as much as 1000 meters high. The sharpness with which these features stand out is attributed to the absence of erosion under submarine conditions and to the fact that there has been little sedimentation. They also testify to crustal rigidity, particularly since it is considered that some of them occur in undoubted exposures of the sima.

The data furnish the means for a new attack on the structure and tectonics of the region and throw additional light on the controversial subject of the origin of island arcs and foredeeps and the nature of geosynclines.

In dealing with the geologic structure the author is careful to emphasize the limitations necessarily imposed on him. Too much reliance cannot be placed on submarine morphology for the interpretation of the deeper structure. Various forms of positive and negative relief are recognizable. The negative forms are divided into two main types: basins with flat bottoms and steep sides; and oblong, trenchlike basins with tapering ends, many of them linked in long festoons. The origin of the first type is explained by downfaulting en bloc and of the second, for the most part, by the action of a horizontal compressive force operating as in the case of normal synclines. There is considerable conflicting evidence regarding the age of these features, but the indications favor late Tertiary.

The theoretical part of the report may be said to begin with a discussion of the definitions and nature of geosynclines. The author considers that the oblong, synclinal troughs of the second type most nearly resemble the trough of sediment from which folded mountain chains such as the Alps have originated. Submarine landslides, thought by some to have played so important a part in Alpine structure, do not appear to be operative here. Soft sediment was found accumulating on slopes of 15°.

Considerable space is given to the theories proposed by various authors concerning the formation of island arcs and foredeeps. Kuenen considers none of them thoroughly satisfactory, however. The modified continental-drift hypothesis of Wegener is not adequate to explain the structure of the region. There are various indications that make it apparent that Australia has not drifted far, relative to the East Indies. "All the movement made by Australia was obtained by tectonic compression in the East Indies in the same manner as all the movement made by British India was obtained by tectonic compression in the central mountains of Asia."

This is the most comprehensive report on the East Indies yet published. Both as regards the new data it contains and as a review and a synthesis of the main problems exemplified by the region, it ranks as a notable contribution.

H. C. STETSON

The Problems of Race

Julian S. Huxley and A. C. Haddon. **We Europeans: A Survey of "Racial" Problems.** viii and 246 pp.; maps, diagrs., ills., index. Harper & Brothers, New York and London, 1936. $2.50. 8¼ x 6 inches.

The writers of this book give us a keynote in the statement that a nation is a group united by a common error as to their origins and a common hatred of their neighbors, and they proceed to show us how different national groups are from racial groups. The Nordic race in the strict sense is represented by those who carry in their persons a group of characters including a long head (when the cephalic index is above 80 or 81, it is doubtful whether the term "Nordic" should be used); a long, narrow nose; a long, rather bony face; tall, slim build; blond or very light brown hair; and blue eyes. The occurrence of fair coloring, especially in children, without the other associated characters is by no means a criterion of the Nordic type. That type is therefore comparatively uncommon in Germany: none of the present leading political personalities in that country belong to it either in body or in mind! Sweden is far more truly the Nordic home, especially spiritually, but the matter of association of physical and psychical characteristics is far from clear; it is at least certain that the forms of expression of psychical characteristics are variable, indeed plastic, in a way that physical characteristics are not.

It might have been worth while in a book like this one to develop the argument that the maintenance of objectivity of mind is valuable and that this objectivity is the natural advantage that compensates for so many of the disadvantages connected with membership in a minority, for example, or position on a culture frontier. In England Havelock Ellis has shown what a large amount of ability has come out of the Welsh border country, especially in Salop and East Montgomery, and all who know that area will agree with this opinion. Here is a region in which men can easily put themselves into either the Welsh or the English tradition and look at the other from outside; they are not completely absorbed in either the one or the other. This quality gives them a perspective and power of constructive initiative of the utmost value. The analogies in the case of the Jewish intellectuals are obvious and help one to understand how they have made such precious contributions to European culture, not by any means least in Germany.

The book reviews the physical composition of most of the peoples of Europe on the basis of Dr. Haddon's synthetic studies, and at every turn the reader will recognize his distinguished mind and long and wide experience.

Professor A. M. Carr-Saunders contributes a survey of European peoples as emigrants and shows that the early part of the emigration movement of the nineteenth century, with its pioneering spirit, was something very different from the movement as it adapted itself to the minds of people of the second and third generations of industrialization.

Altogether, this book is one to be read and pondered by serious thinkers who are not moved by scaremongering and who value scientific truth and its necessary companion, freedom of conscience.

H. J. Fleure